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Dyson

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(54) **MULTIDIRECTIONAL, SWITCHLESS OVERHEAD SUPPORT SYSTEM**

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/299,803**

(22) Filed: **Apr. 26, 1999**

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/067,079, filed on Apr. 27, 1998, now Pat. No. 5,996,823, and a continuation-in-part of application No. 09/135,380, filed on Aug. 17, 1998, now Pat. No. 6,079,578.

(51) **Int. Cl.**[7] **A61G 7/10**
(52) **U.S. Cl.** **212/336**; 5/83.1; 104/89; 105/148; 105/177; 212/71; 212/270; 212/338; 482/69
(58) **Field of Search** 212/71, 270, 271, 212/331, 332, 336, 337; 5/83.1, 85.1, 86.1; 104/89; 105/148, 177

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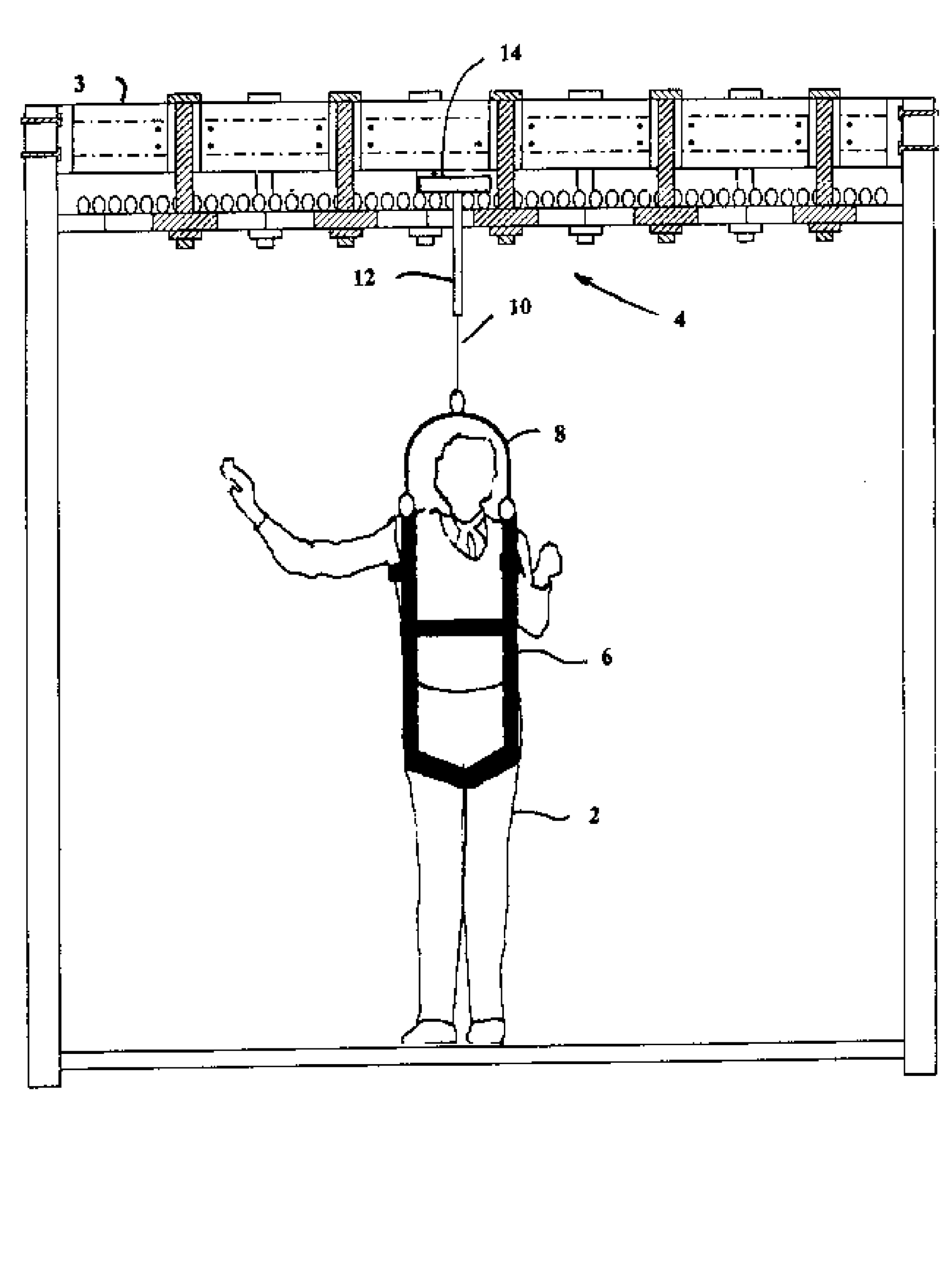
(57) **ABSTRACT**

An overhead support system. A riding surface is located over a space and supports at least one overhead cart from which a load is supported by a tension element. A plurality of spherical elements are positioned between the riding surface and overhead cart and are attached to either the cart or the riding surface. The load can be moved horizontally in the space by applying a horizontal force to the load causing the cart to move over the riding surface while carrying the load in the horizontal direction. In preferred embodiments the riding surface is an array of spoked rimless wheels. In other preferred embodiments the riding surface is a slot track, or the riding surface may be a combination of the array and slot tracks. In other preferred embodiments a hoist assembly is used to raise and lower the load. In a preferred embodiment the hoist assembly is located below the riding surface. In another preferred embodiment, the hoist assembly is located above the riding surface. In preferred embodiments casters are mounted on the top of the riding surface to permit easy horizontal movement of the cart over the casters. In other preferred embodiments the riding surface is flat and casters are mounted on the bottom of the overhead cart.

26 Claims, 23 Drawing Sheets



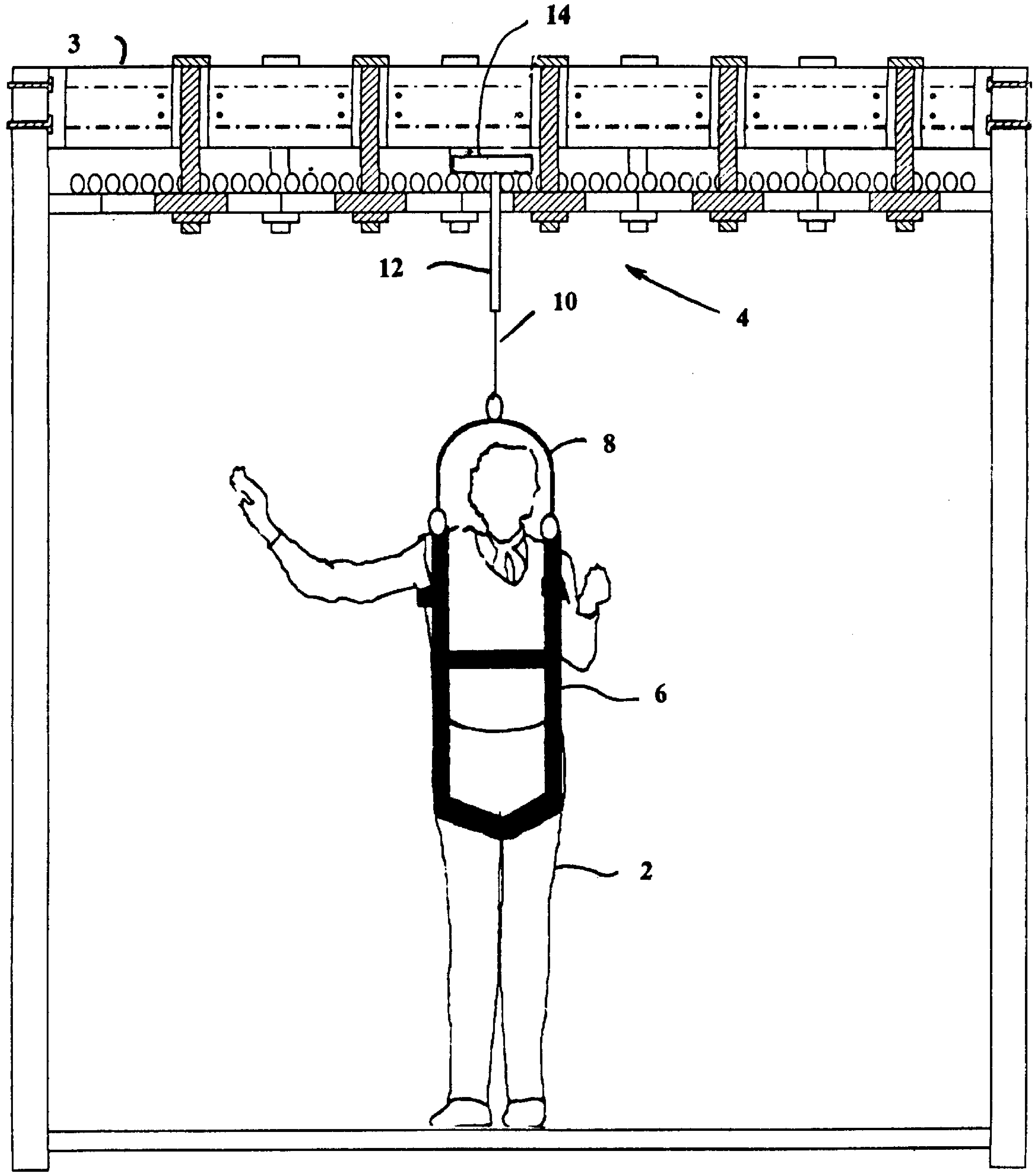


FIG. 1A

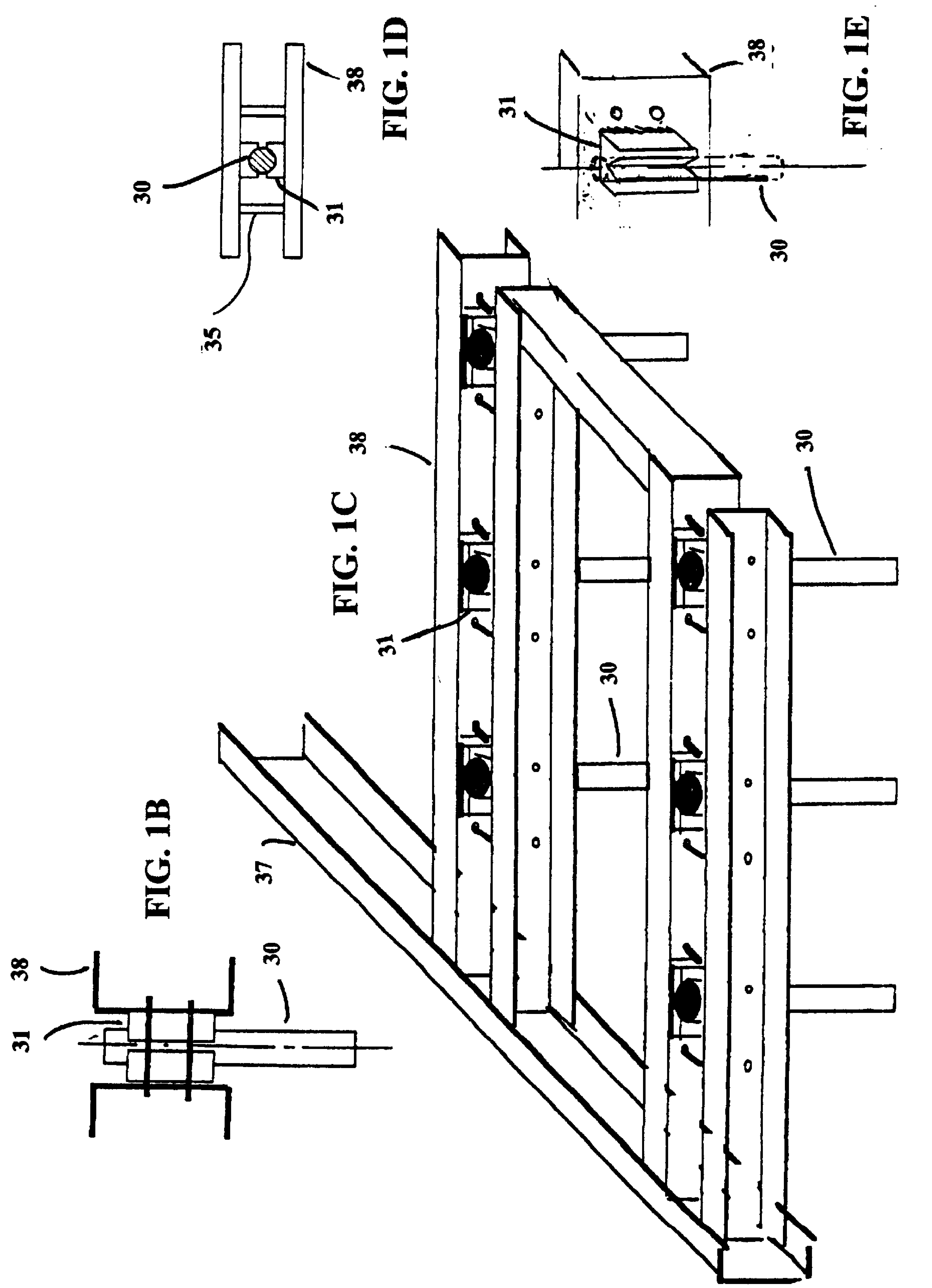


FIG. 1B

FIG. 1C

FIG. 1D

FIG. 1E

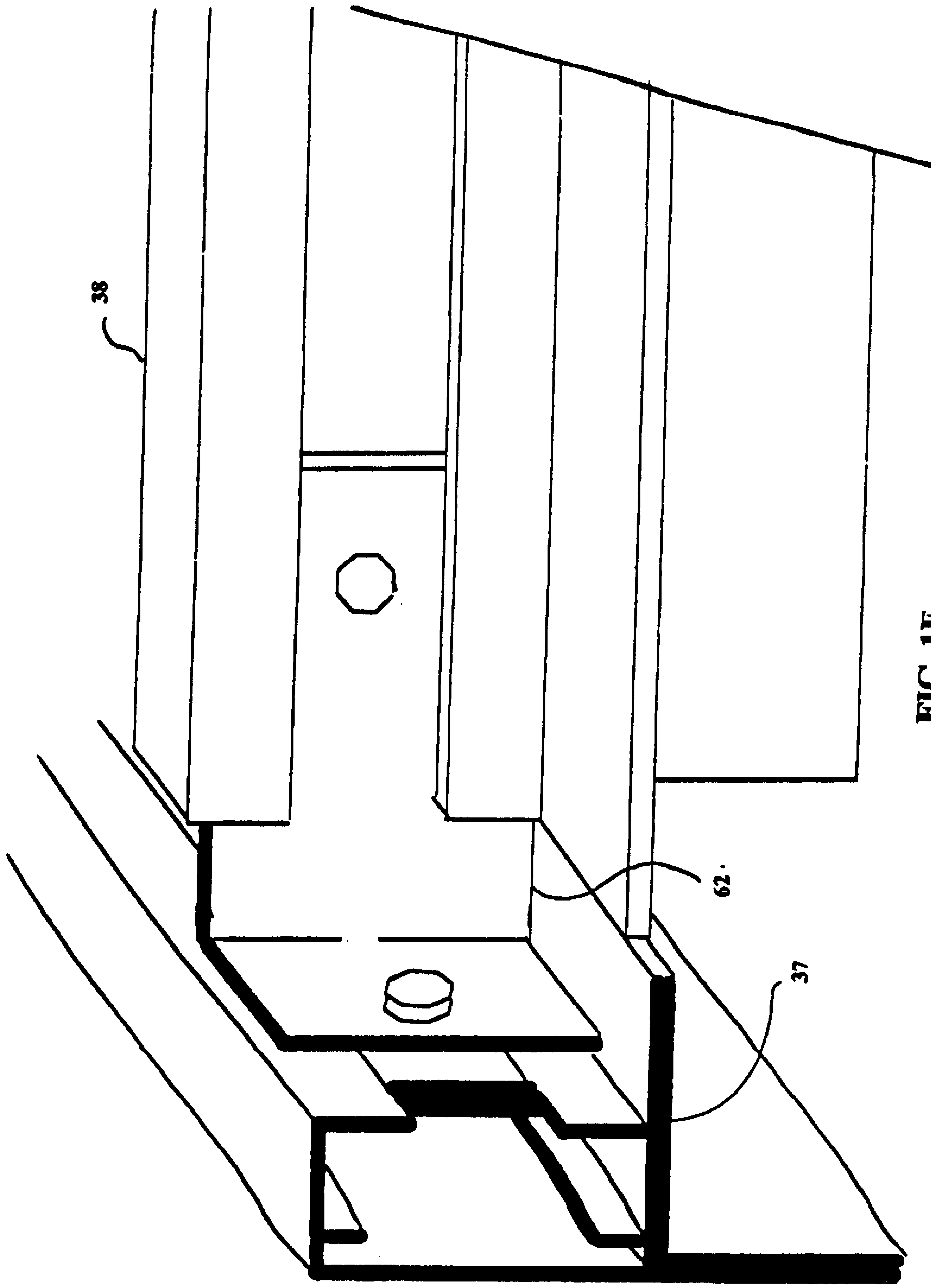


FIG. 1F

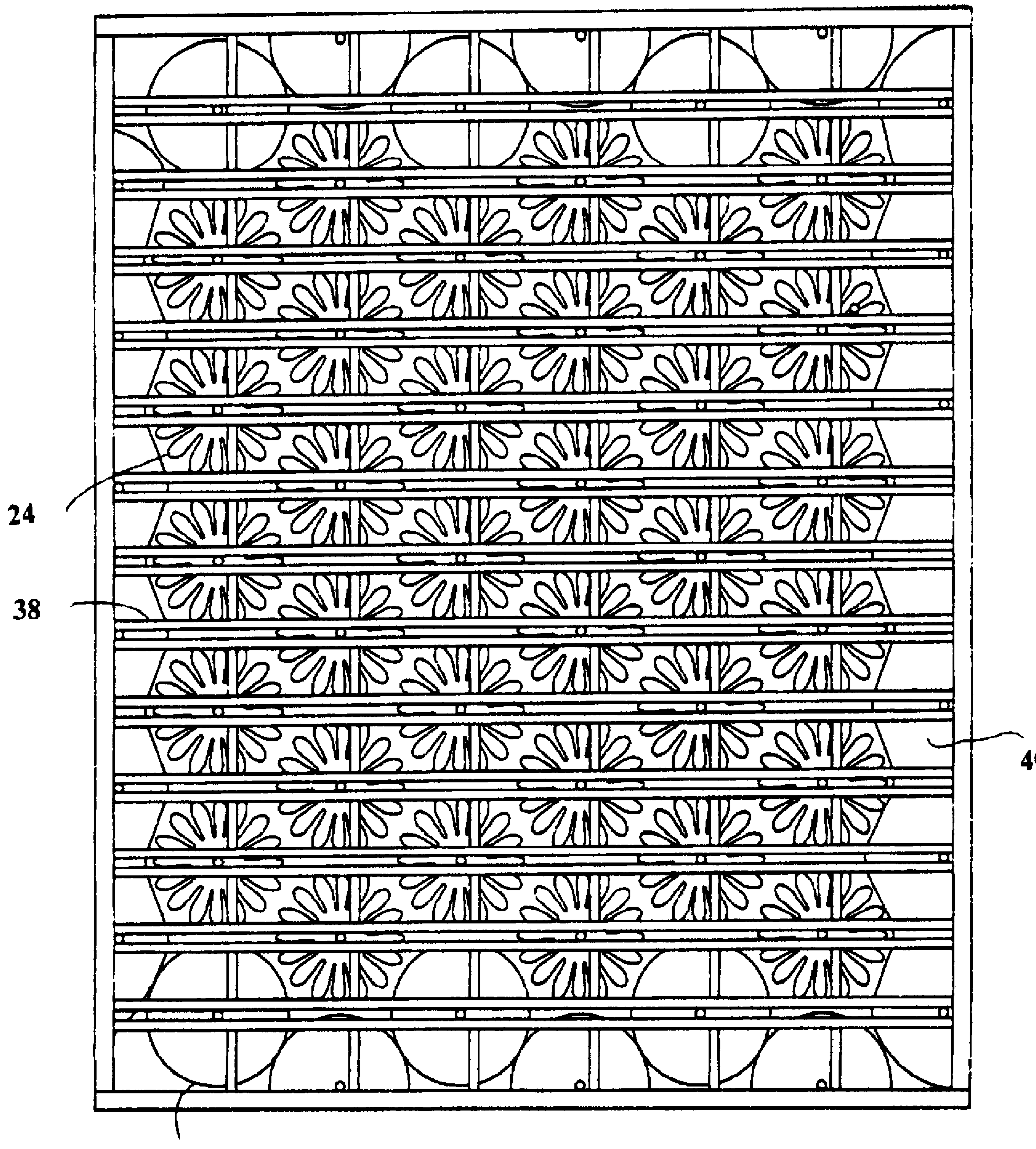


FIG. 2A

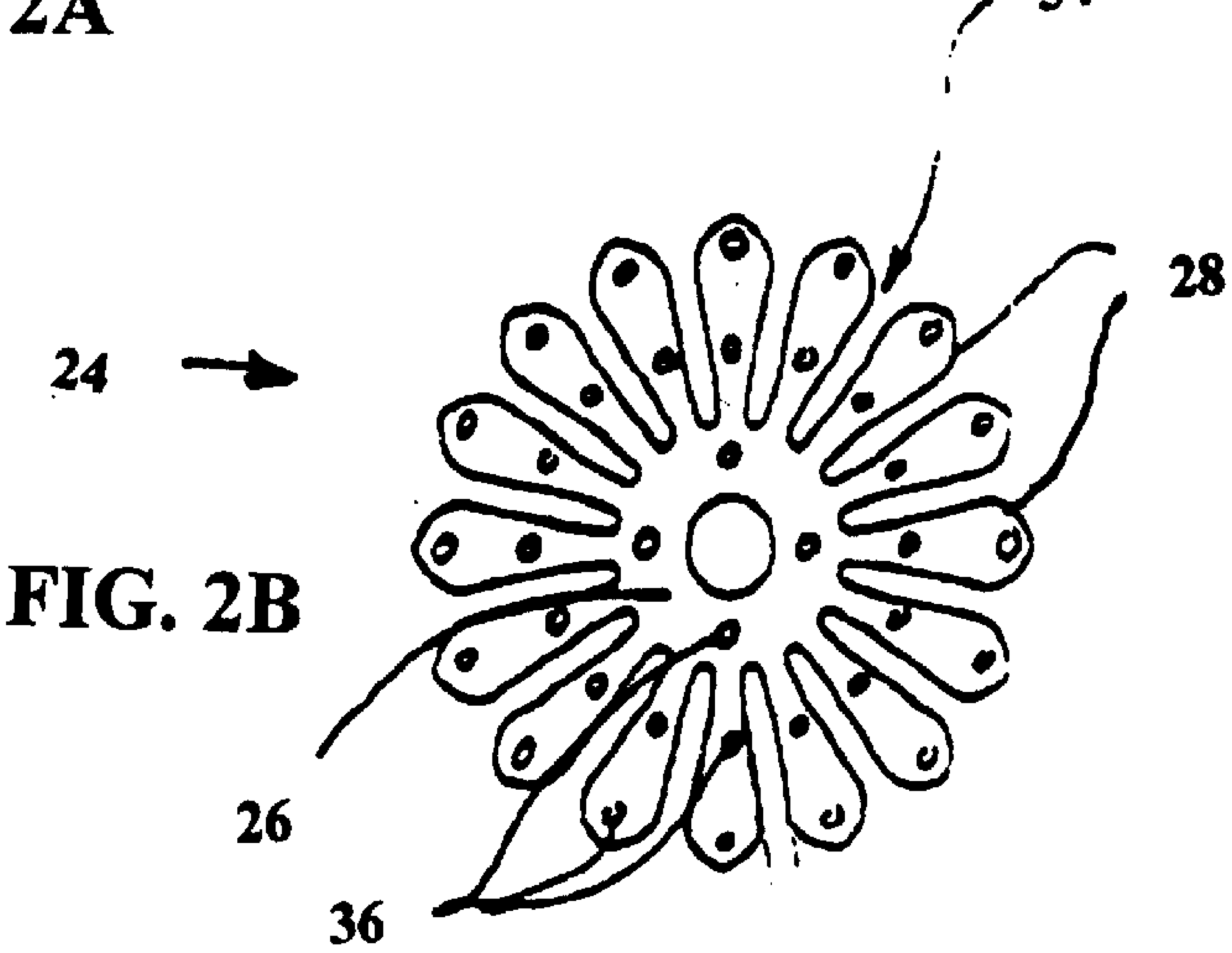


FIG. 2B

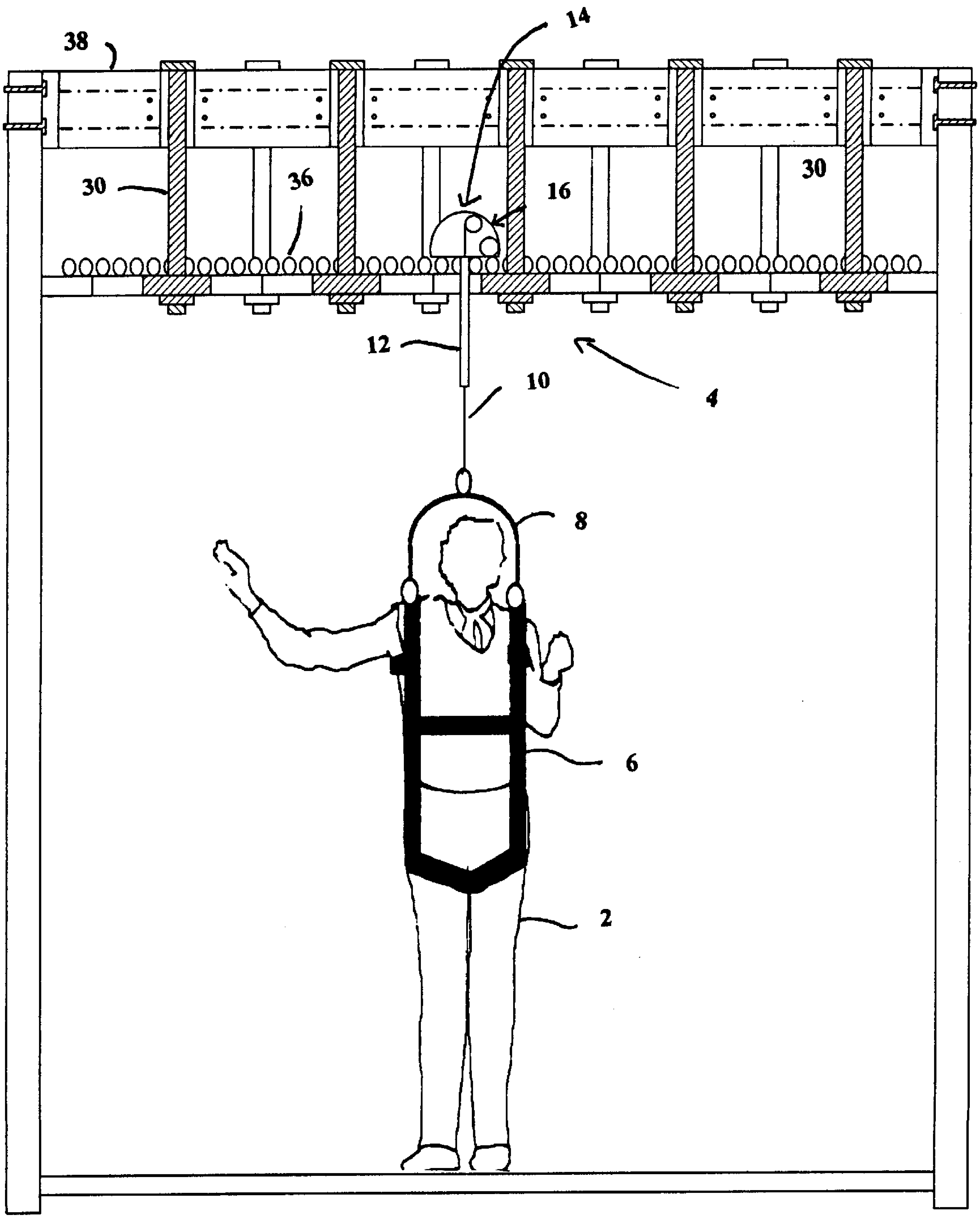


FIG. 3A

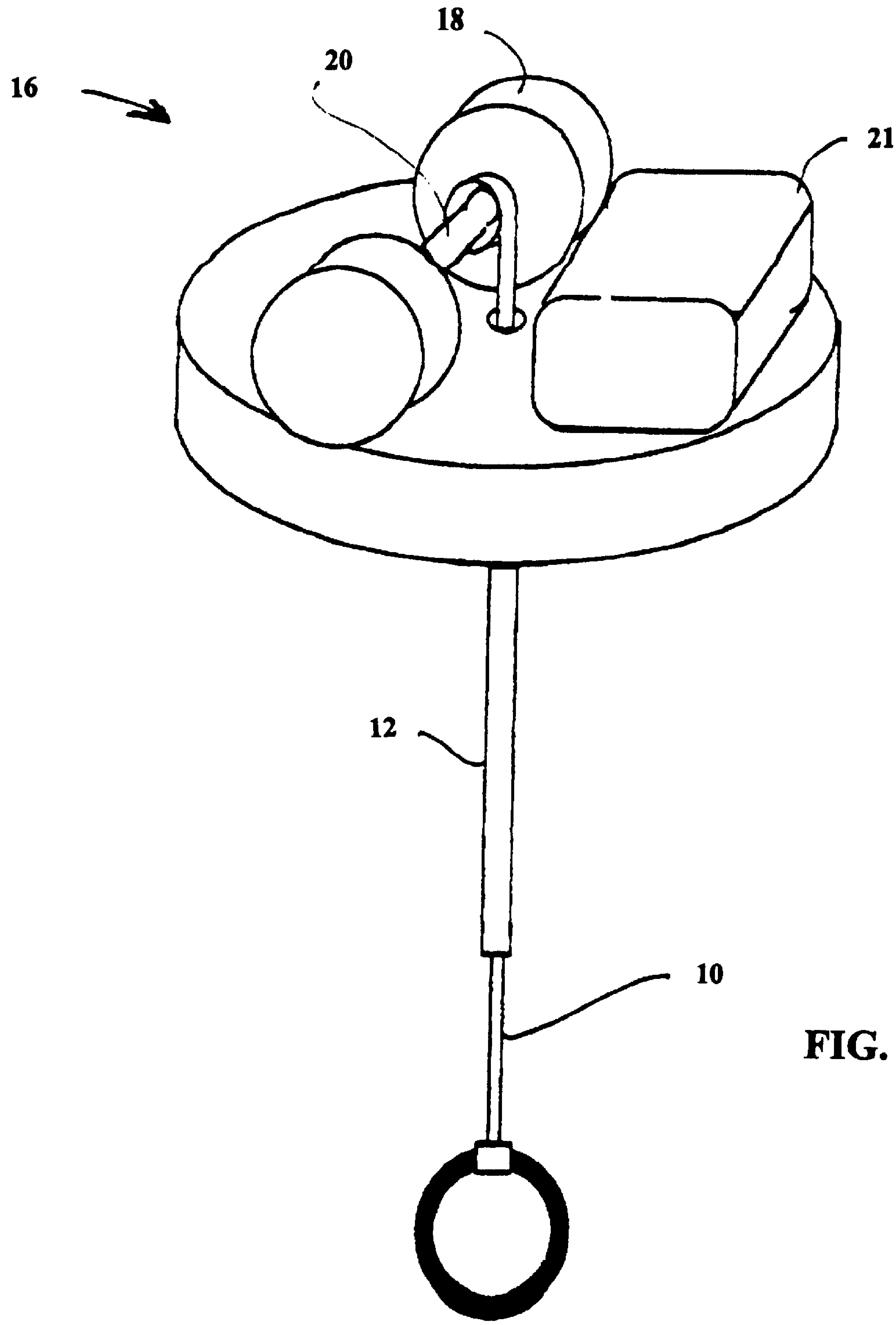


FIG. 3B

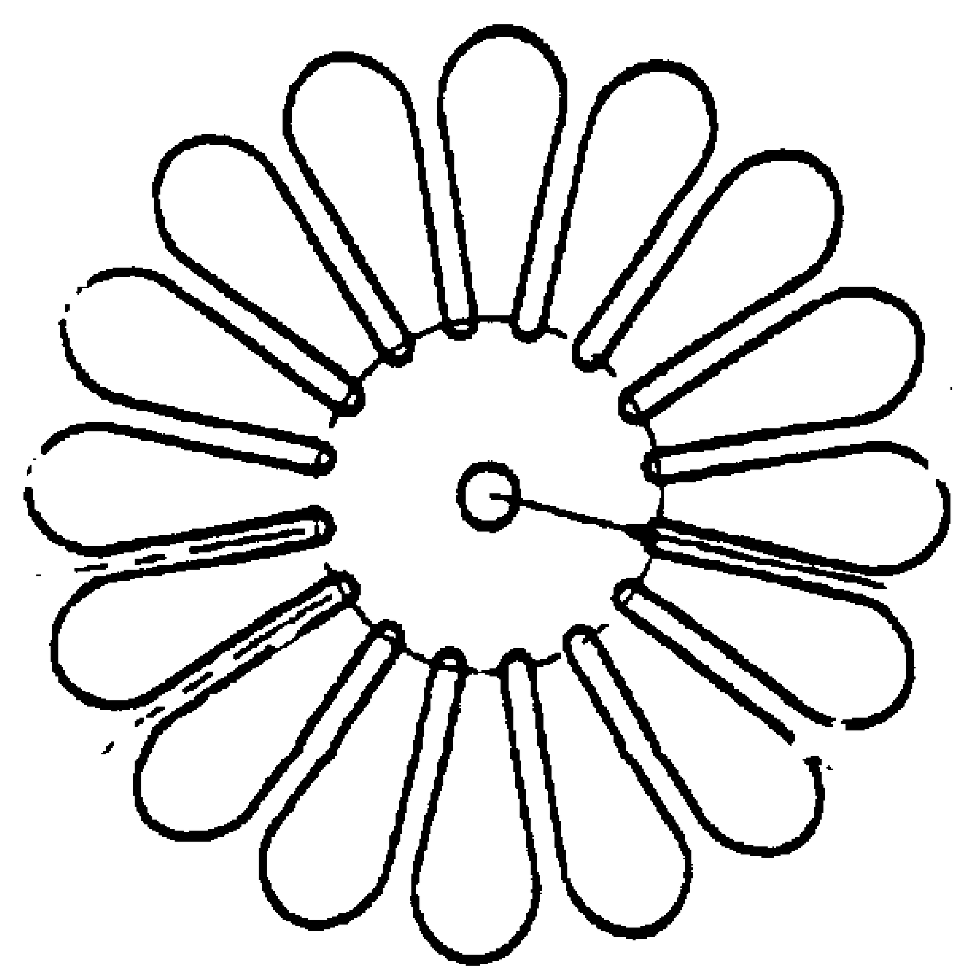


FIG. 4B

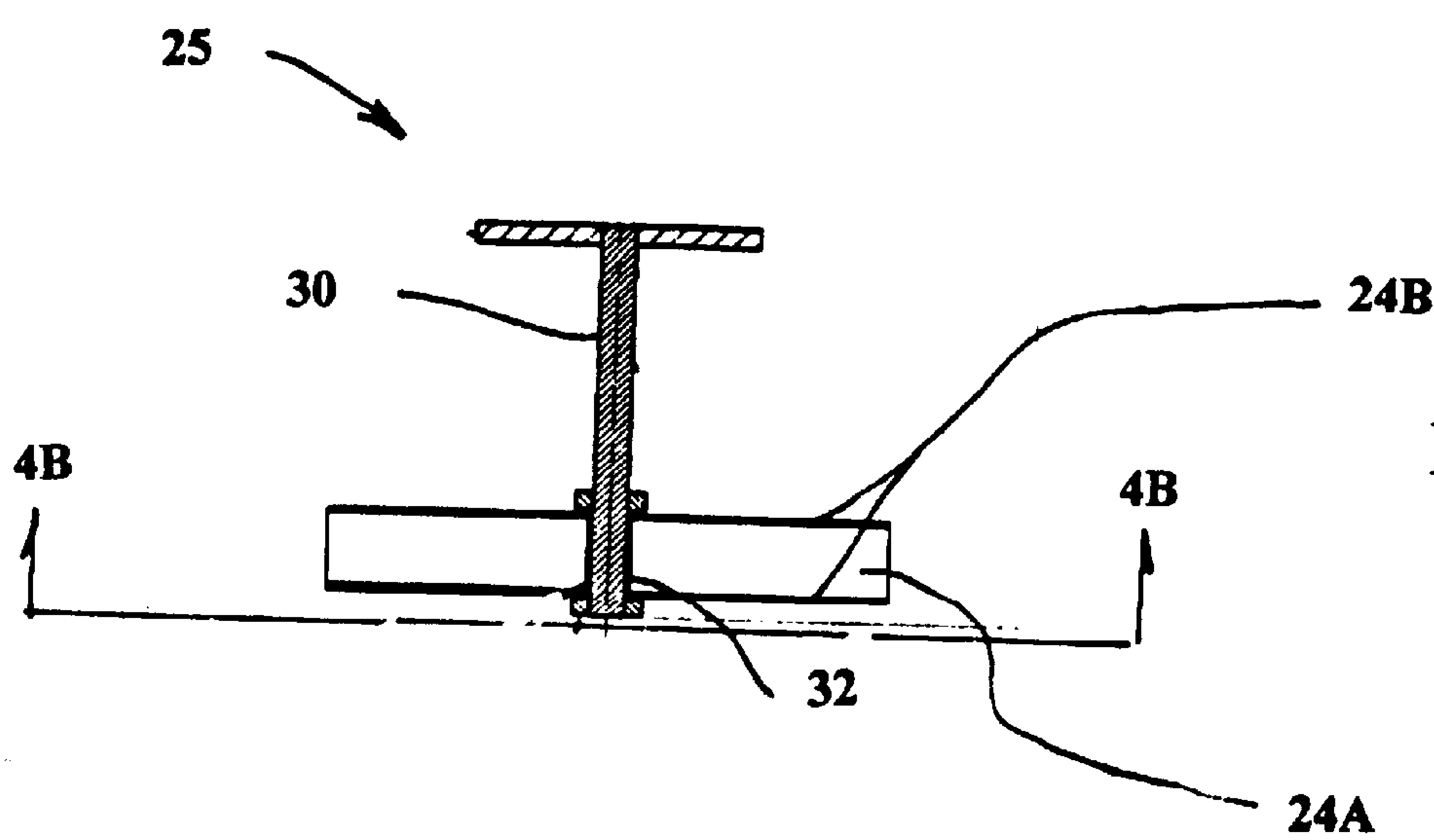


FIG. 4A

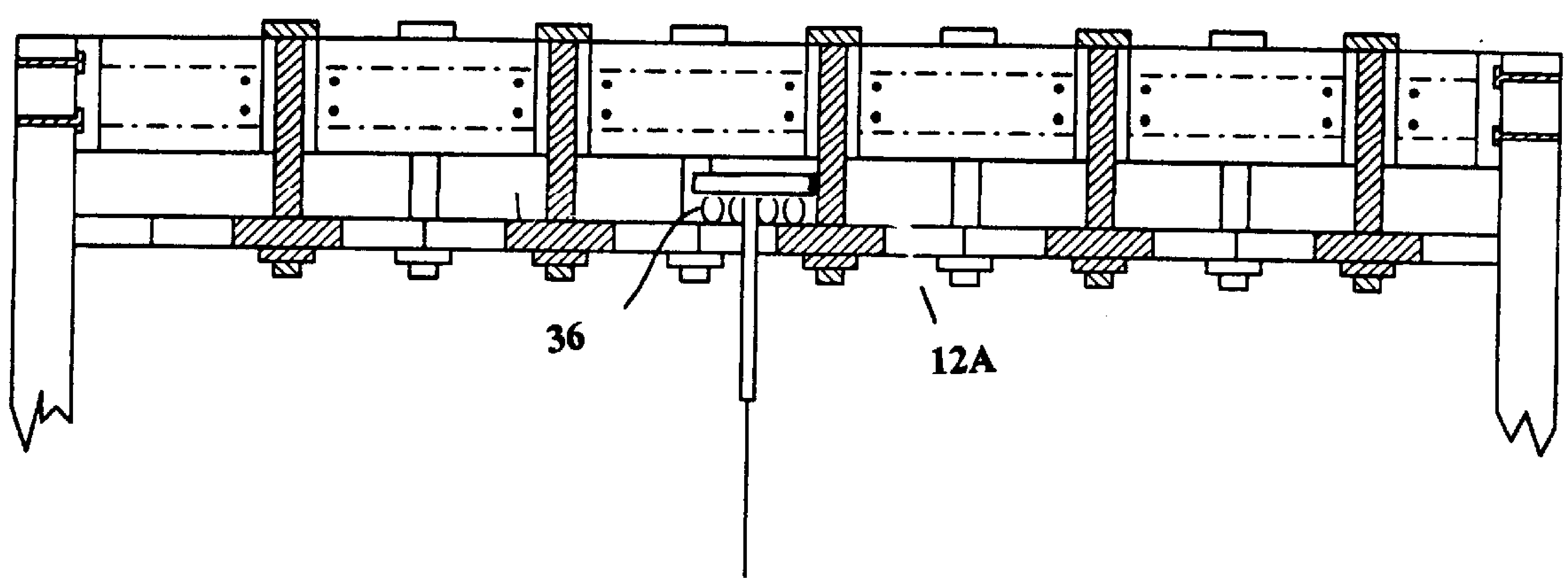


FIG. 5A

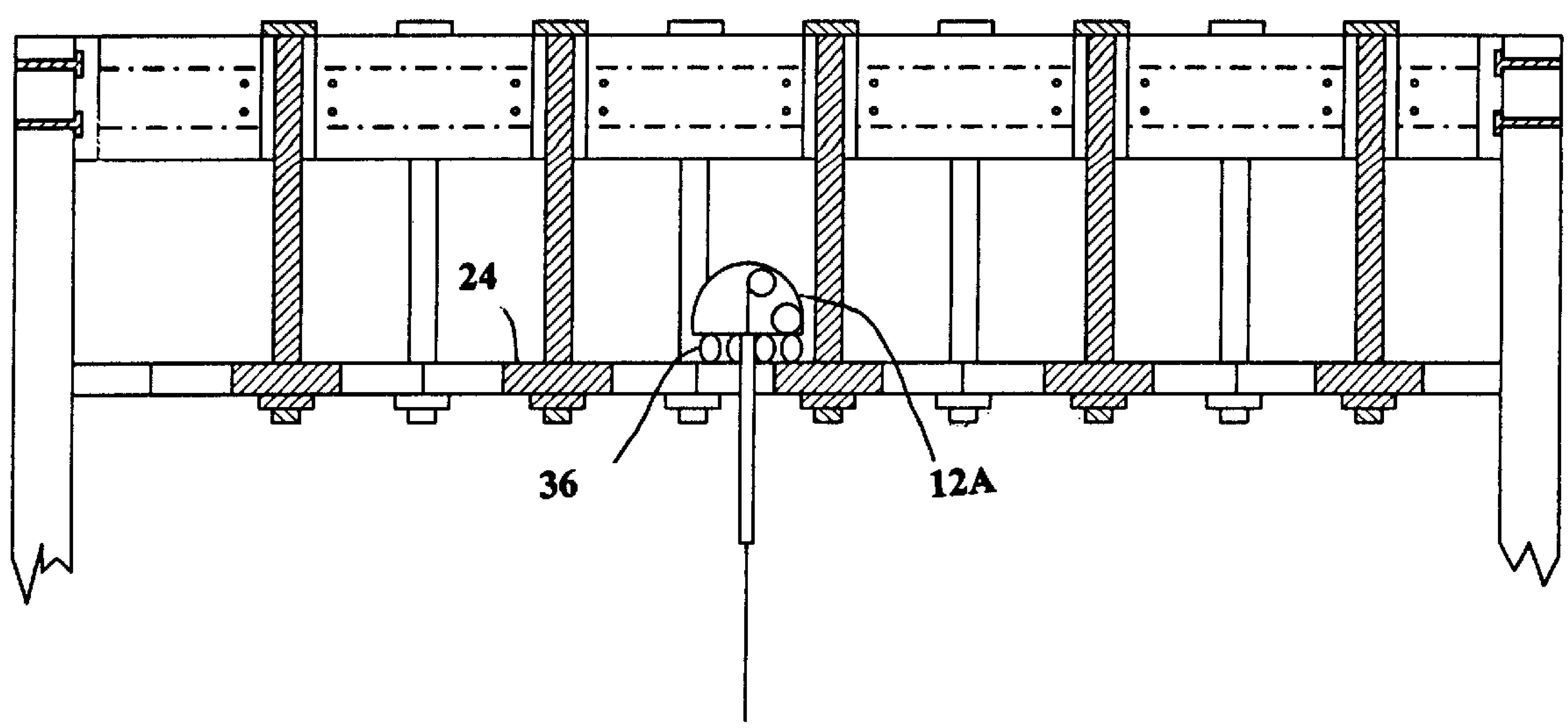


FIG. 5B

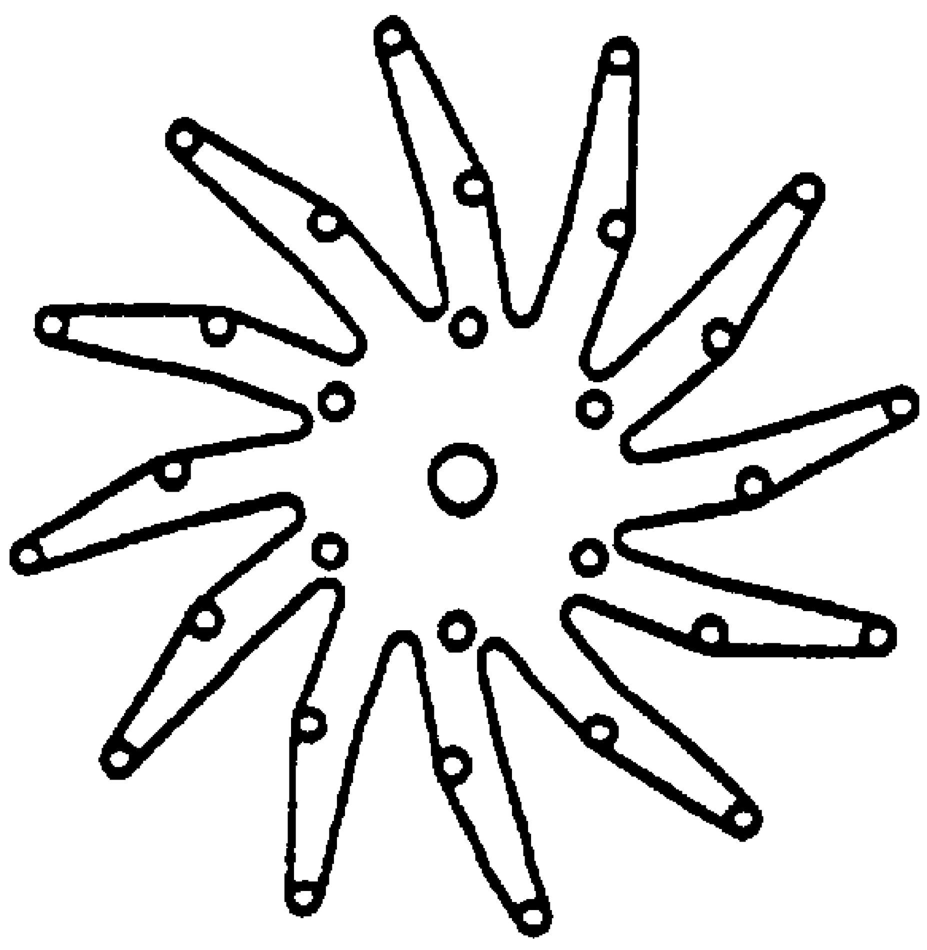


FIG. 6

FIG. 7A

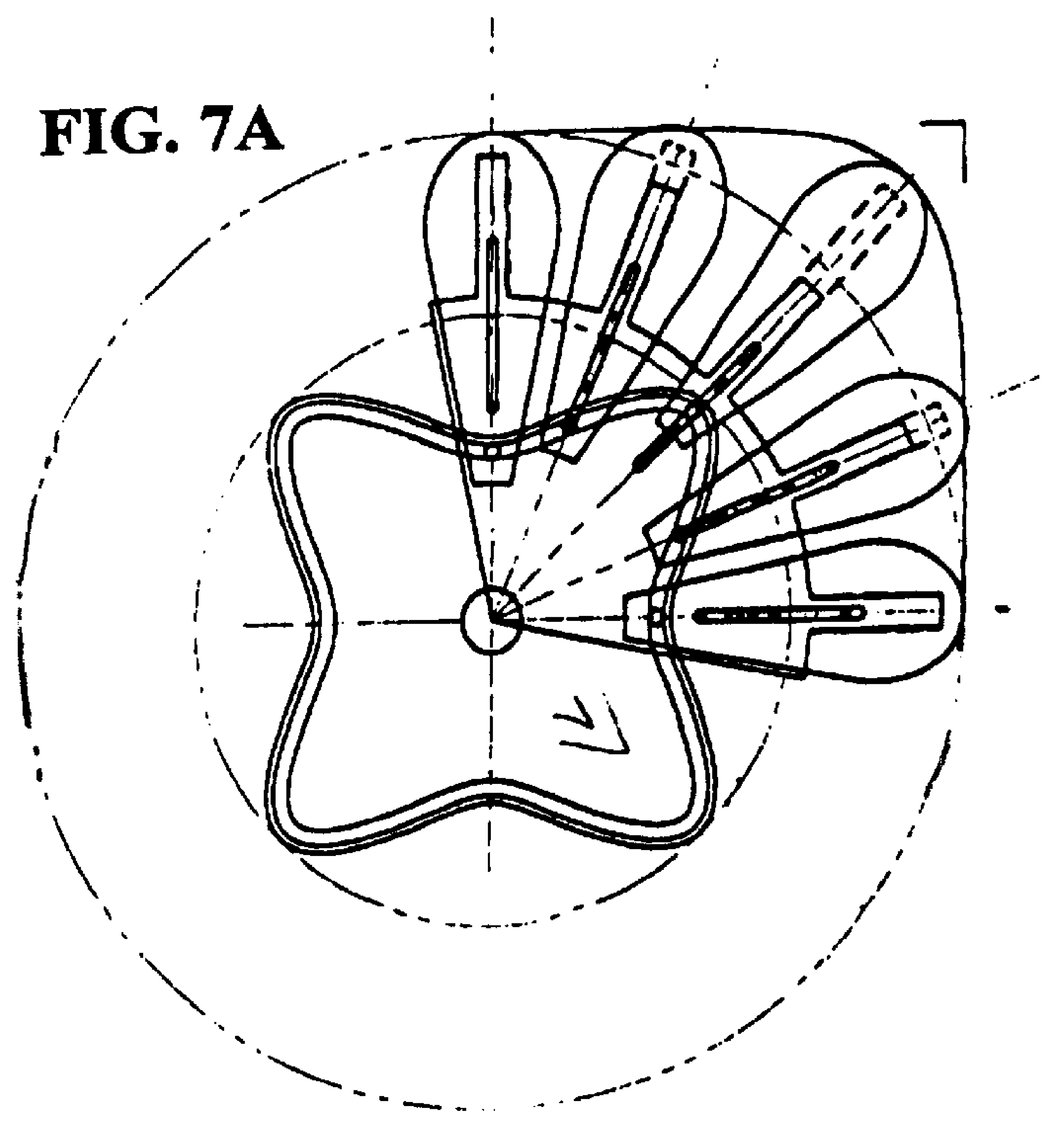
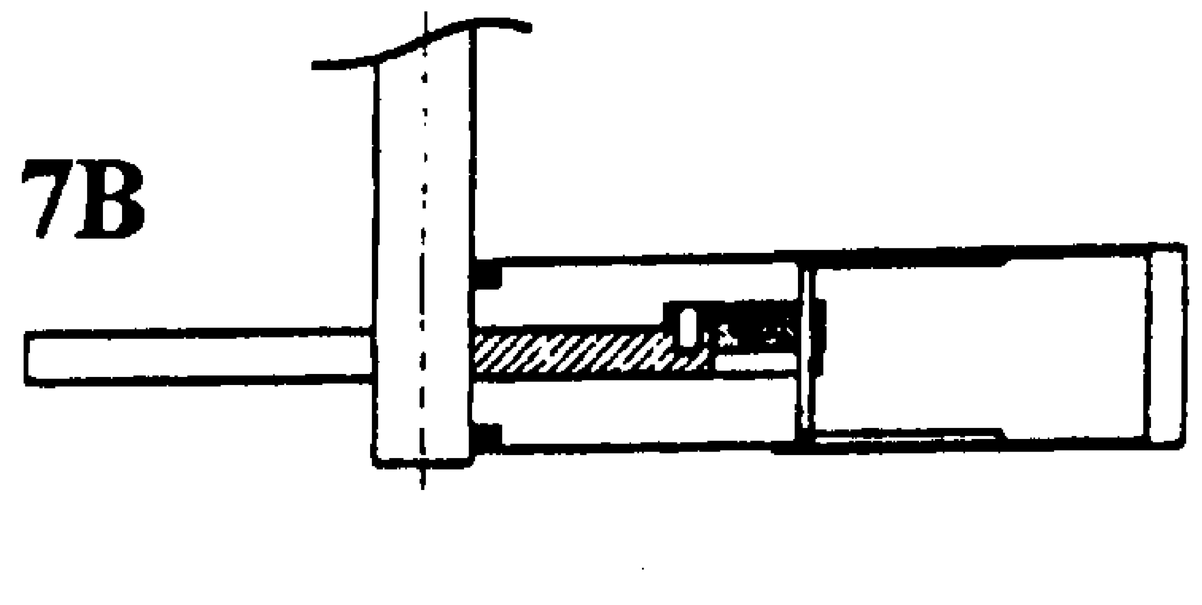


FIG. 7B



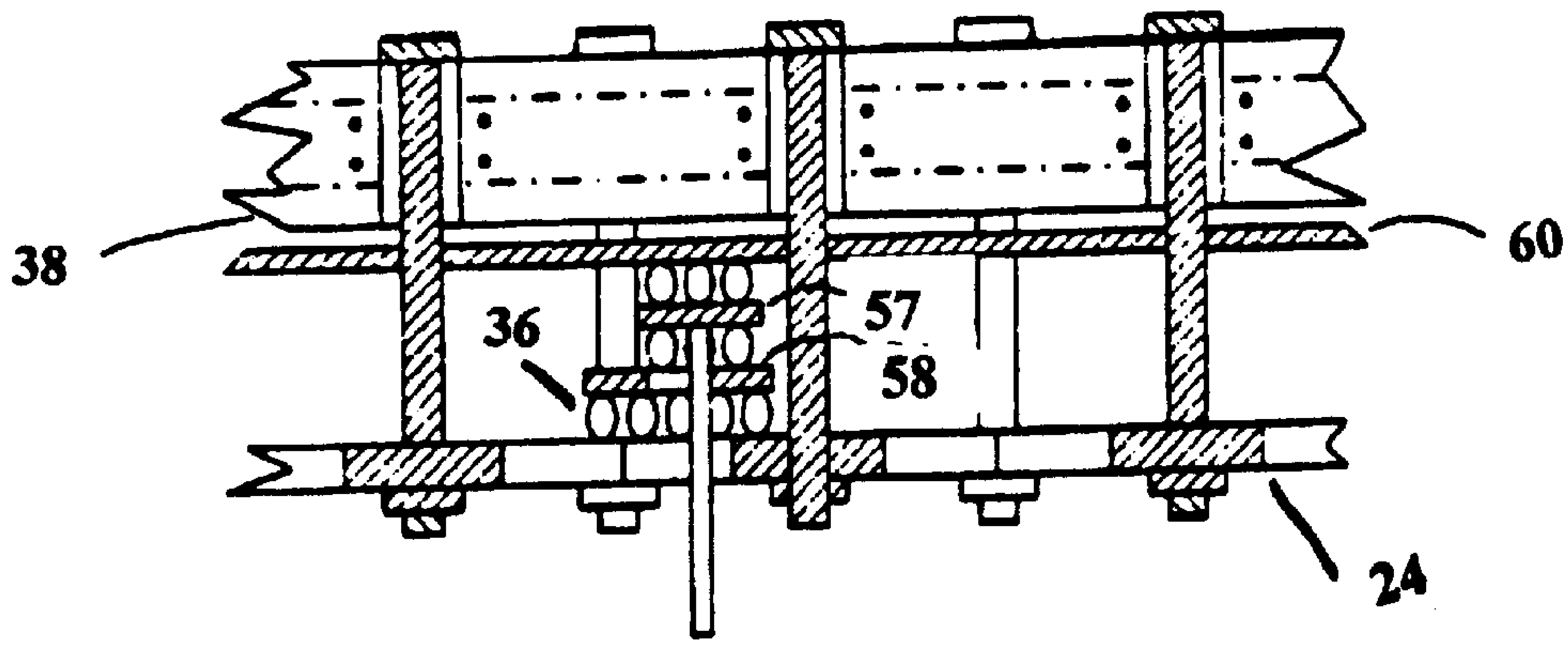


FIG. 8

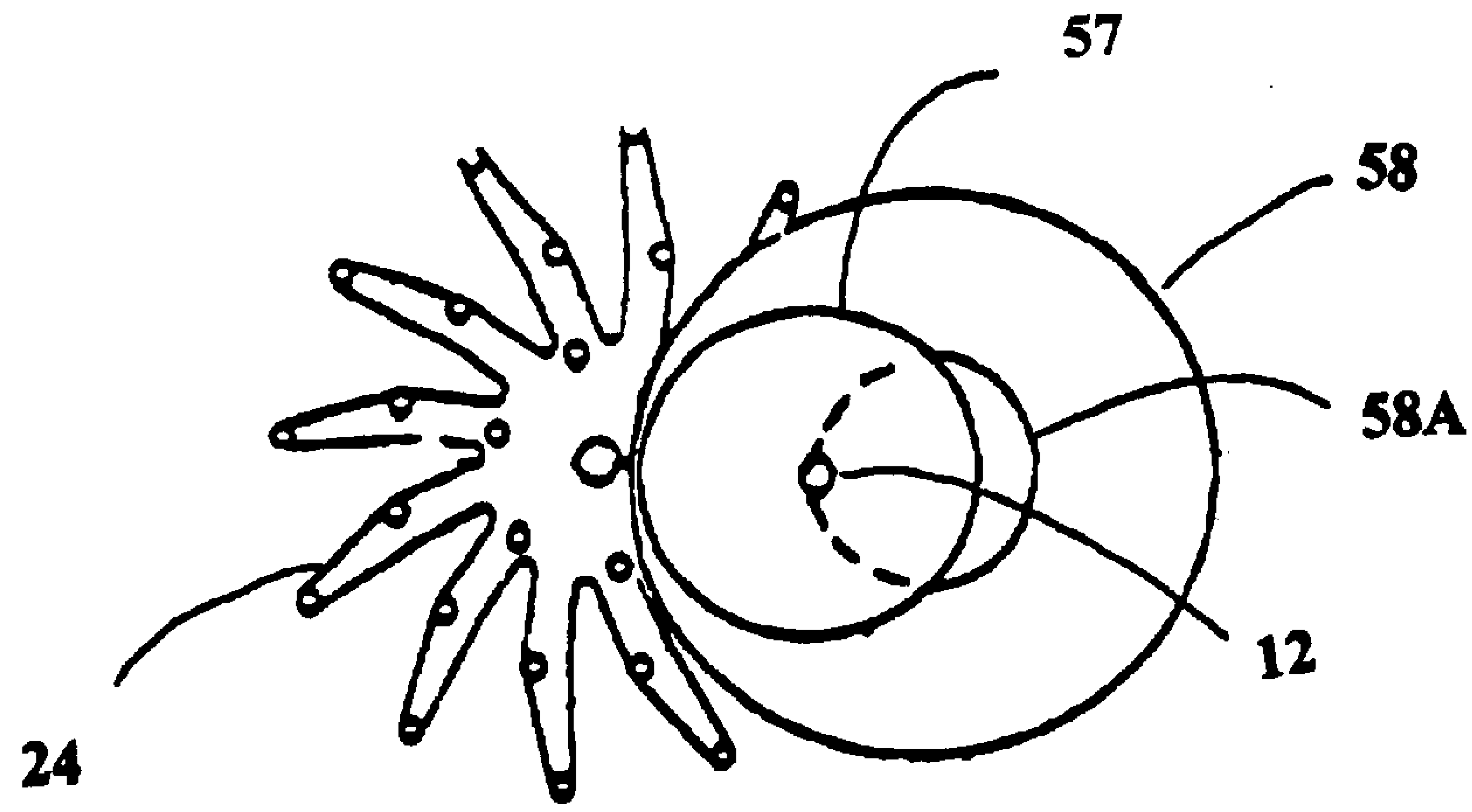


FIG. 9A

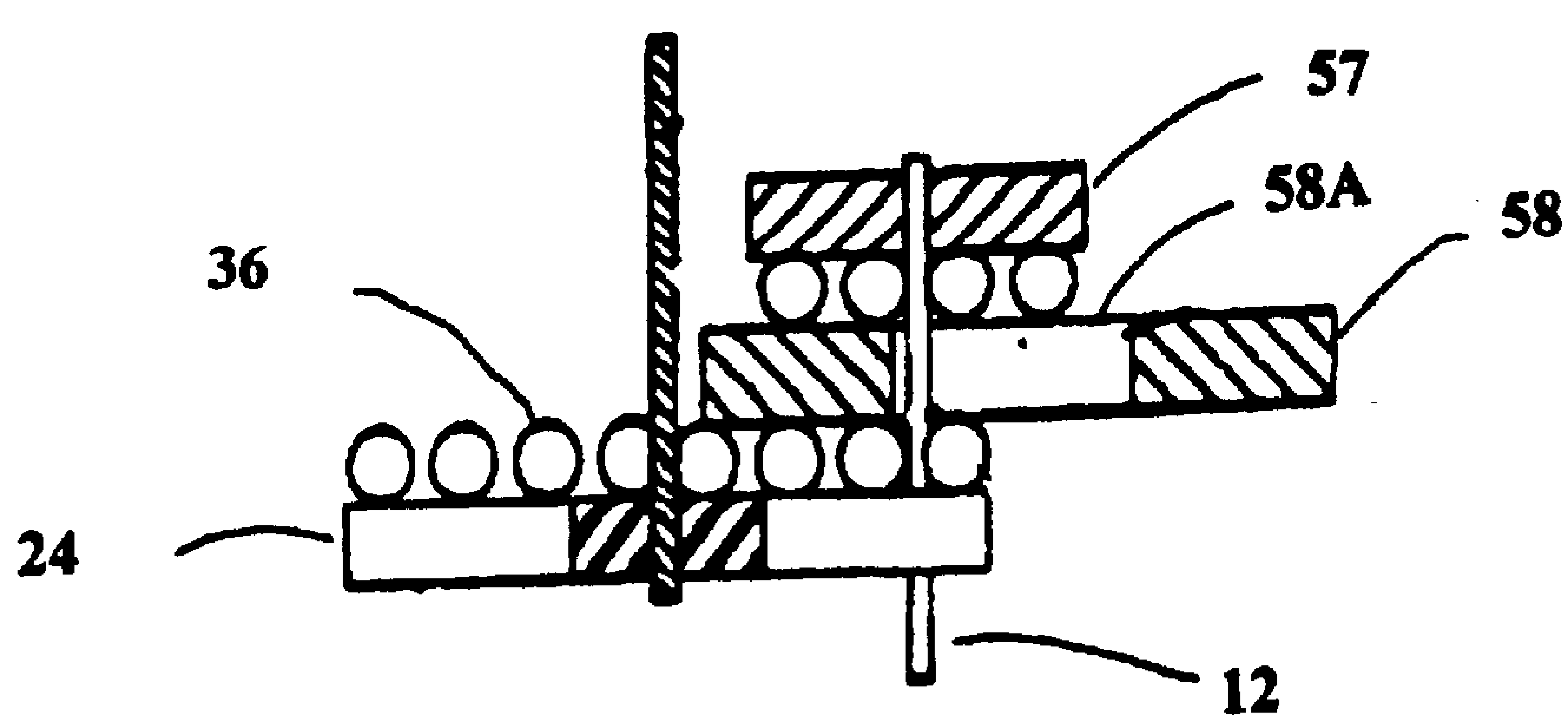


FIG. 9B

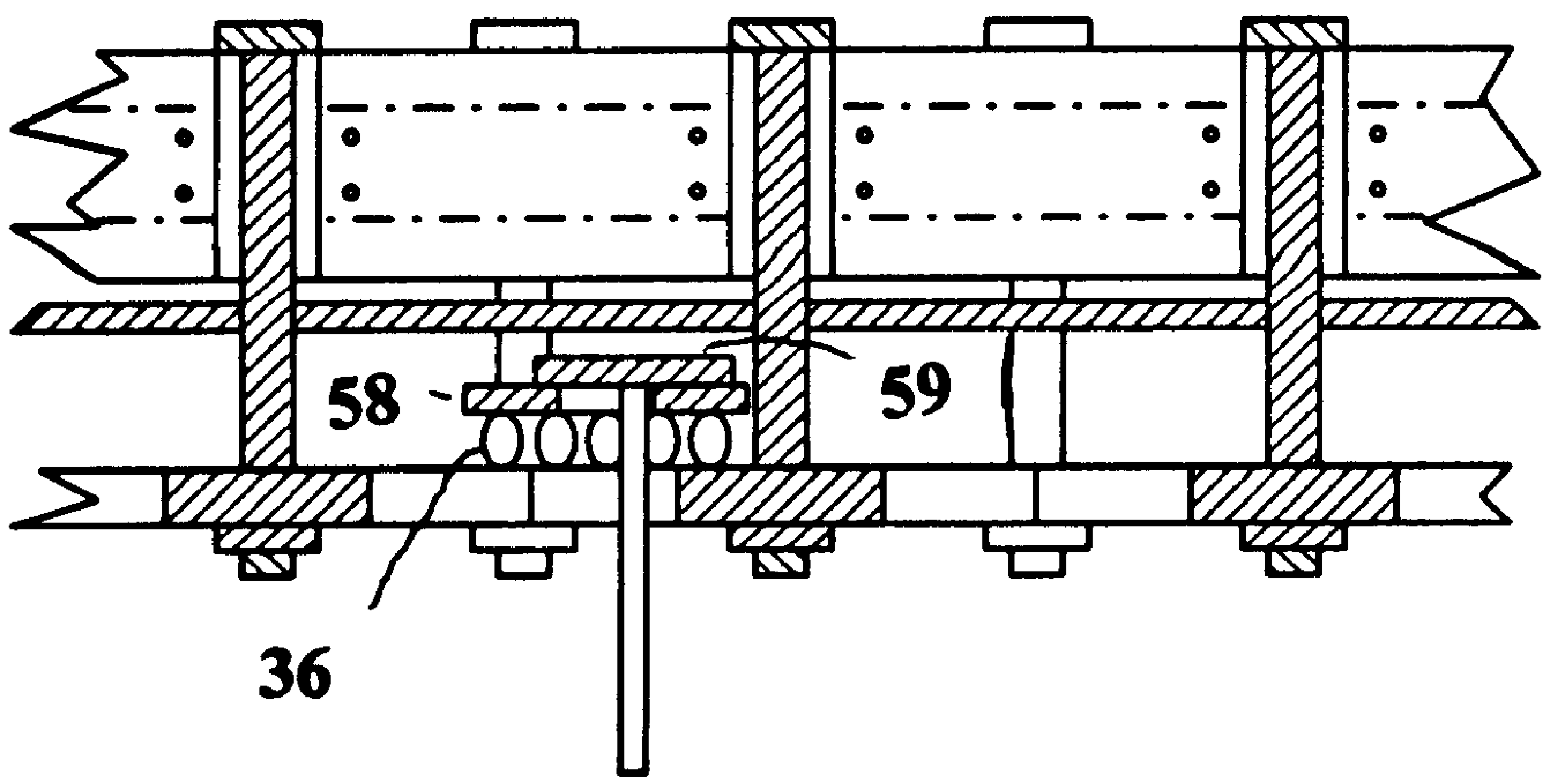


FIG. 10

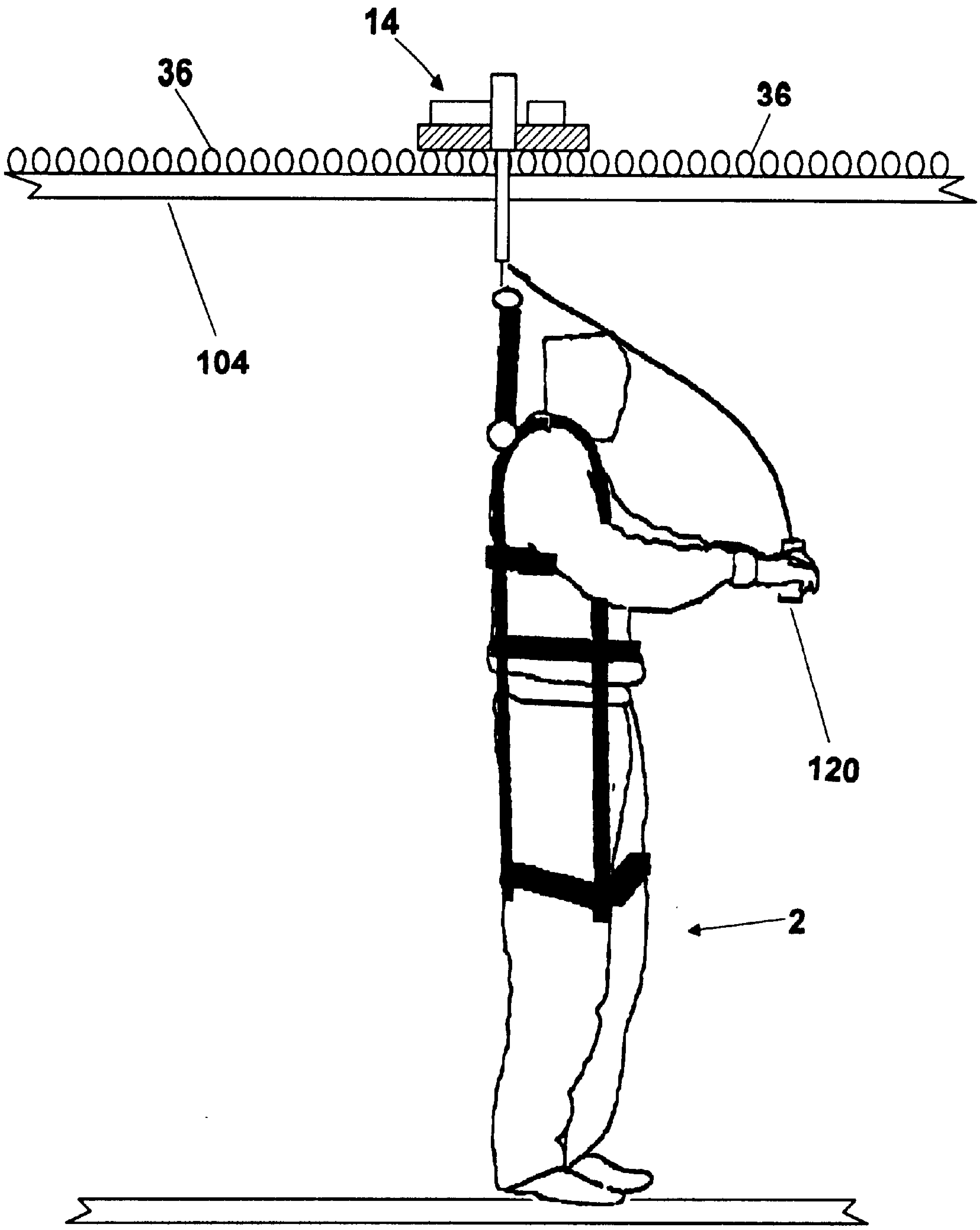


FIG. 11A

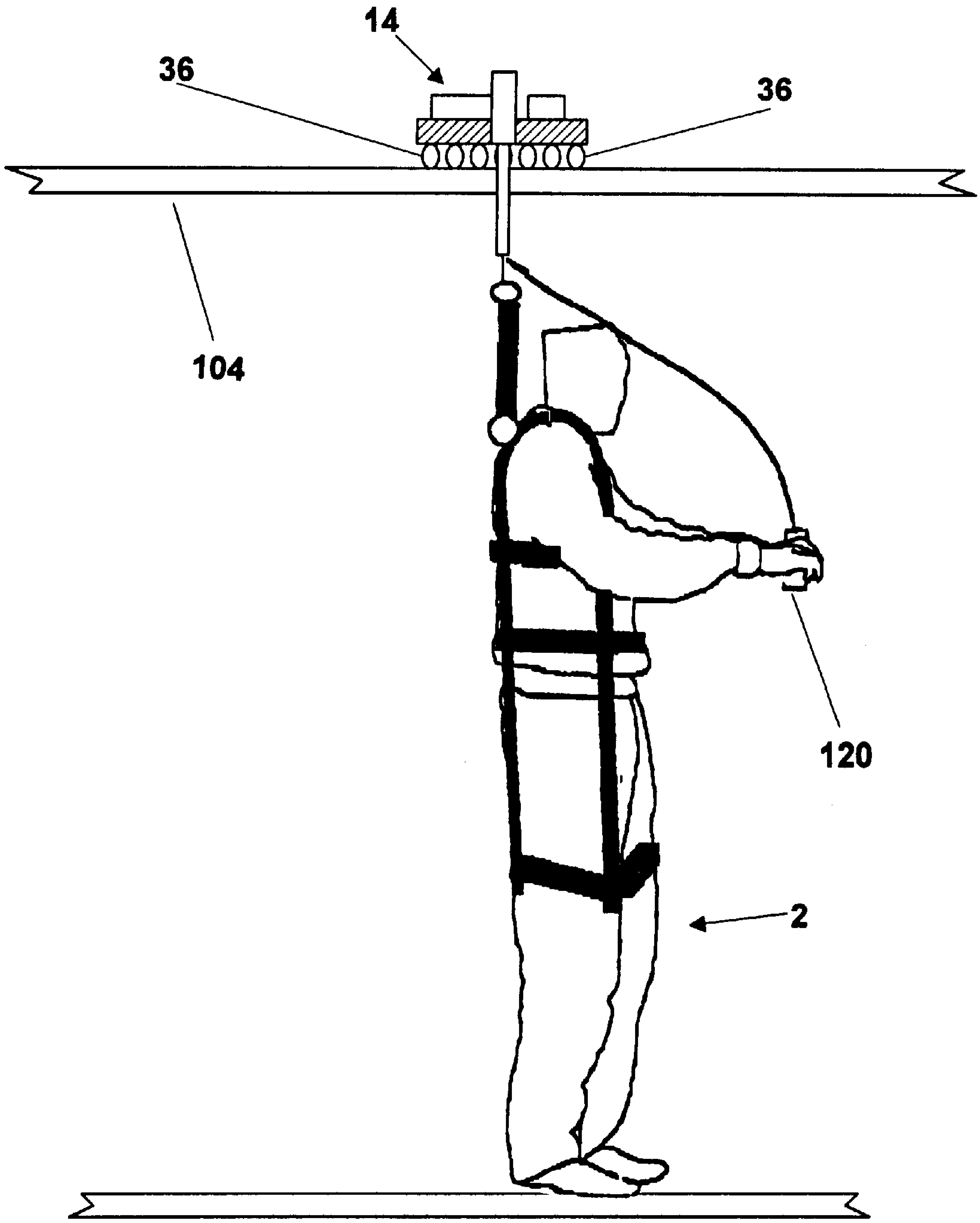


FIG. 11B

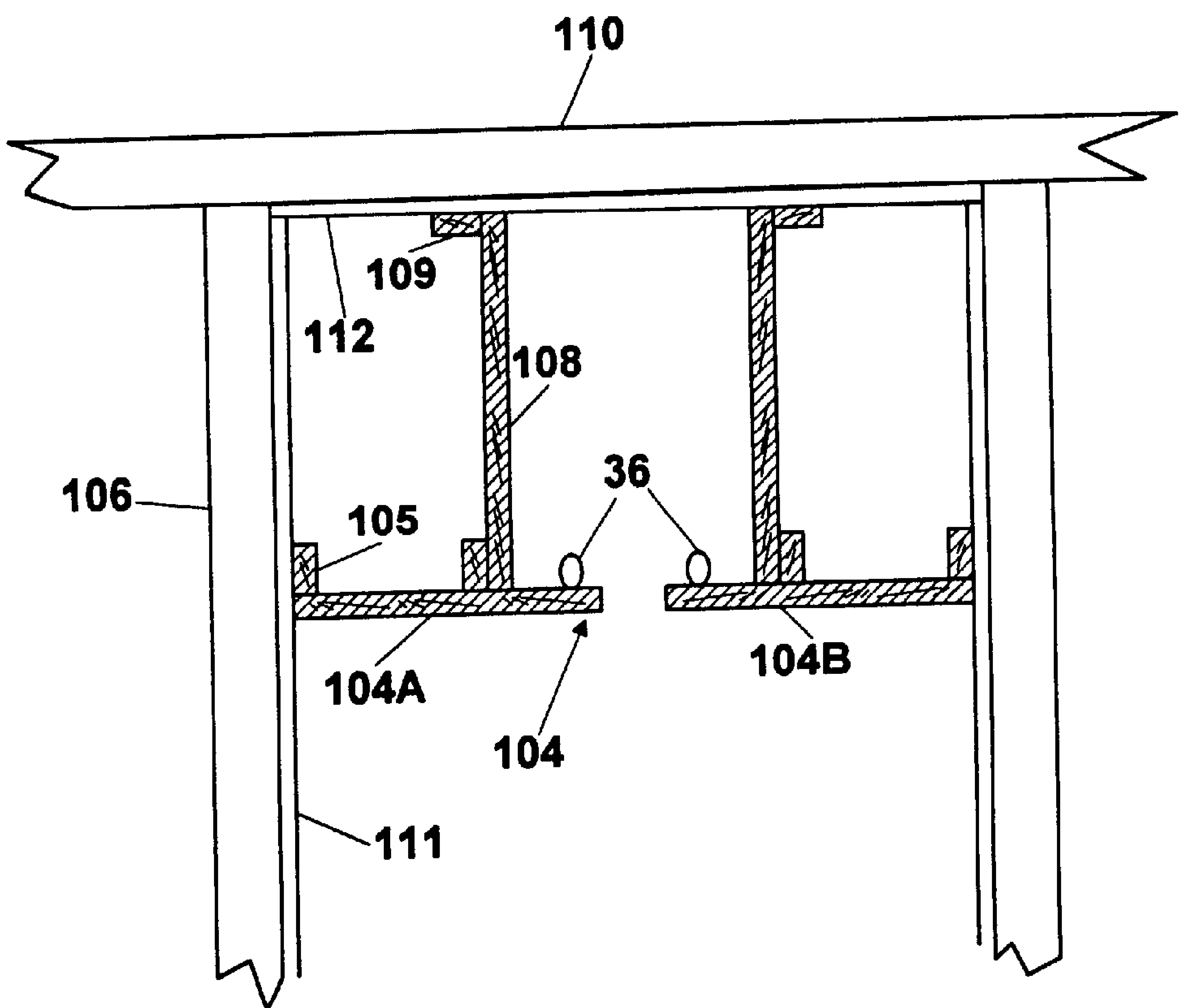


FIG. 12A

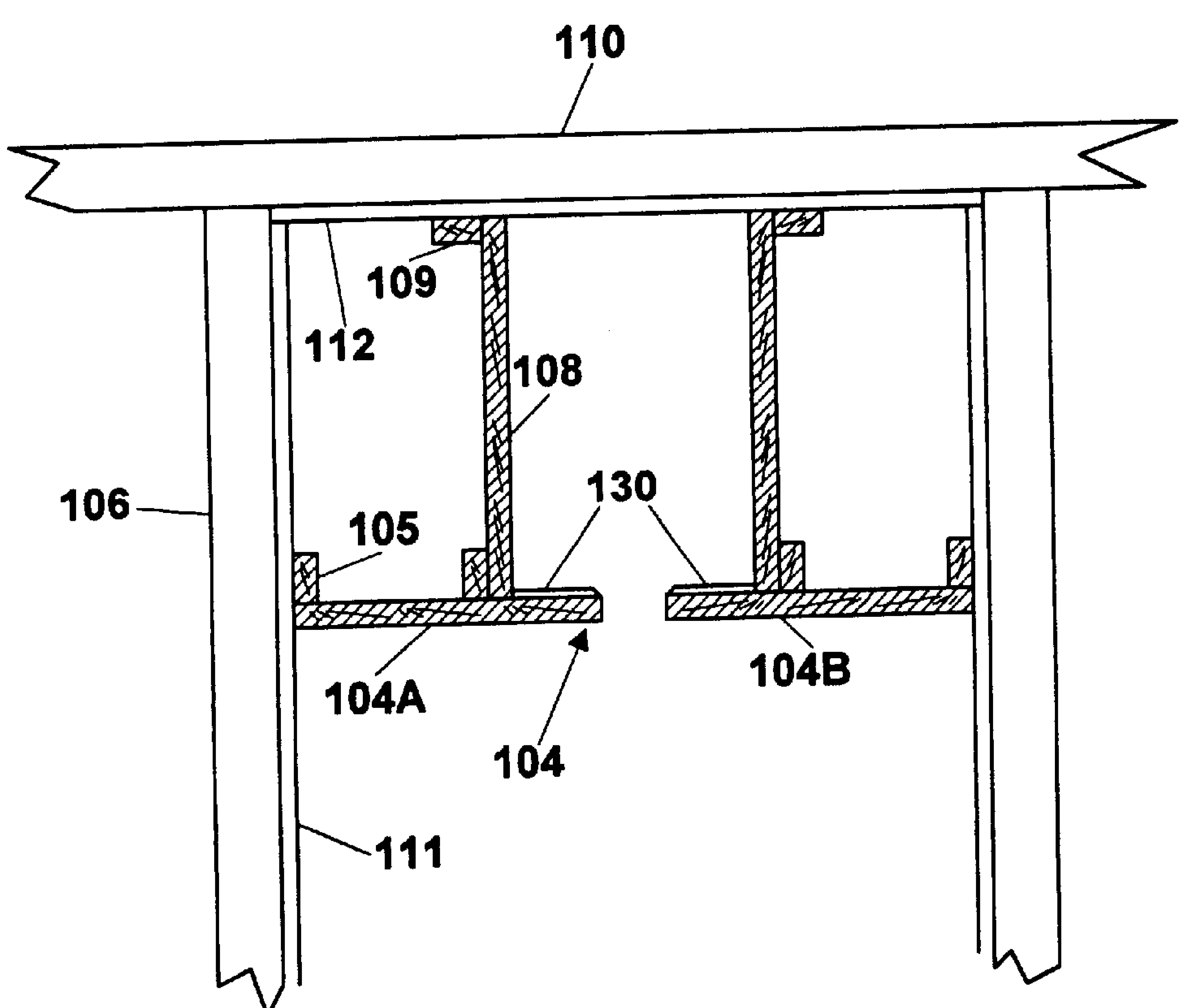


FIG. 12B

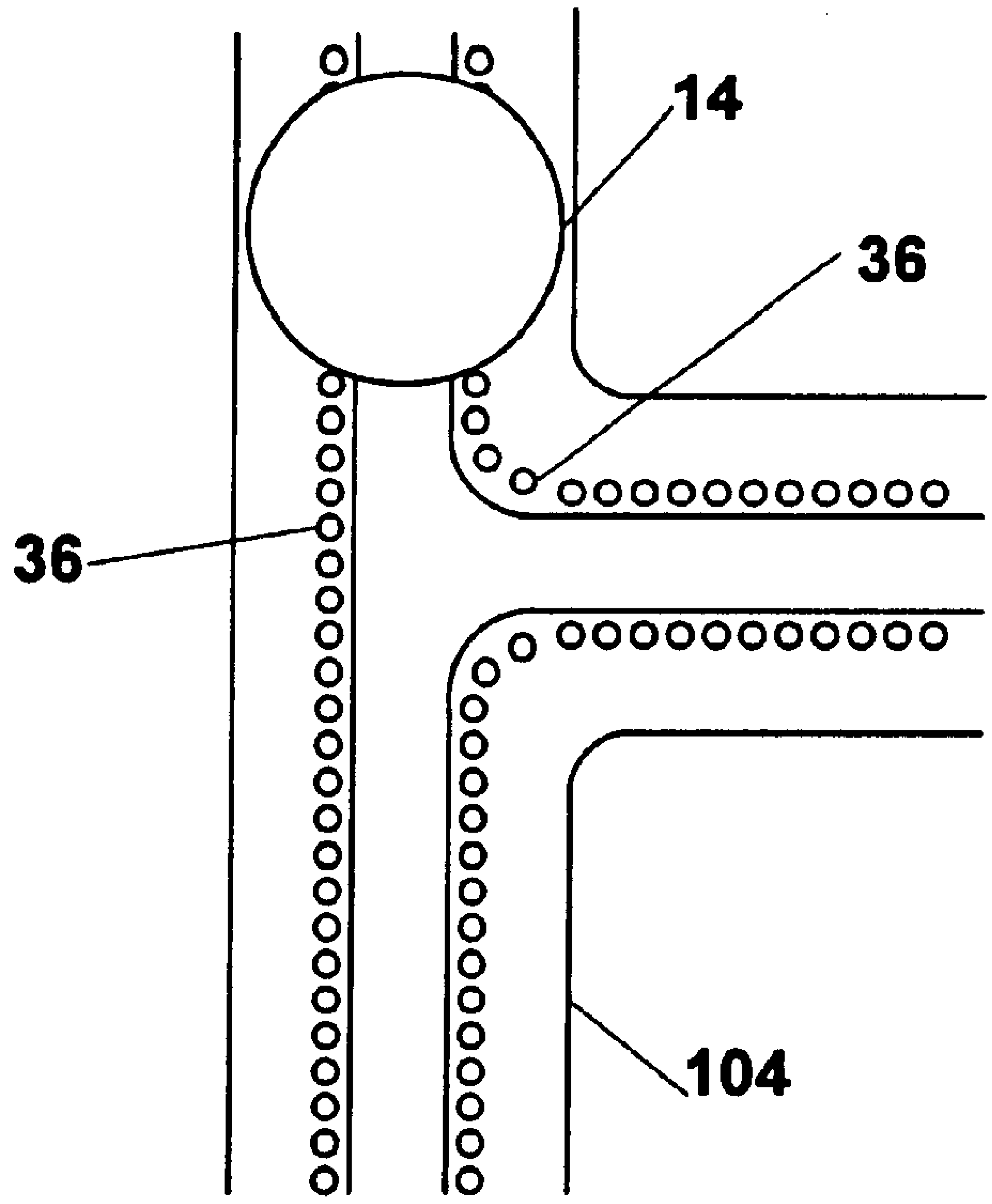


FIG. 13A

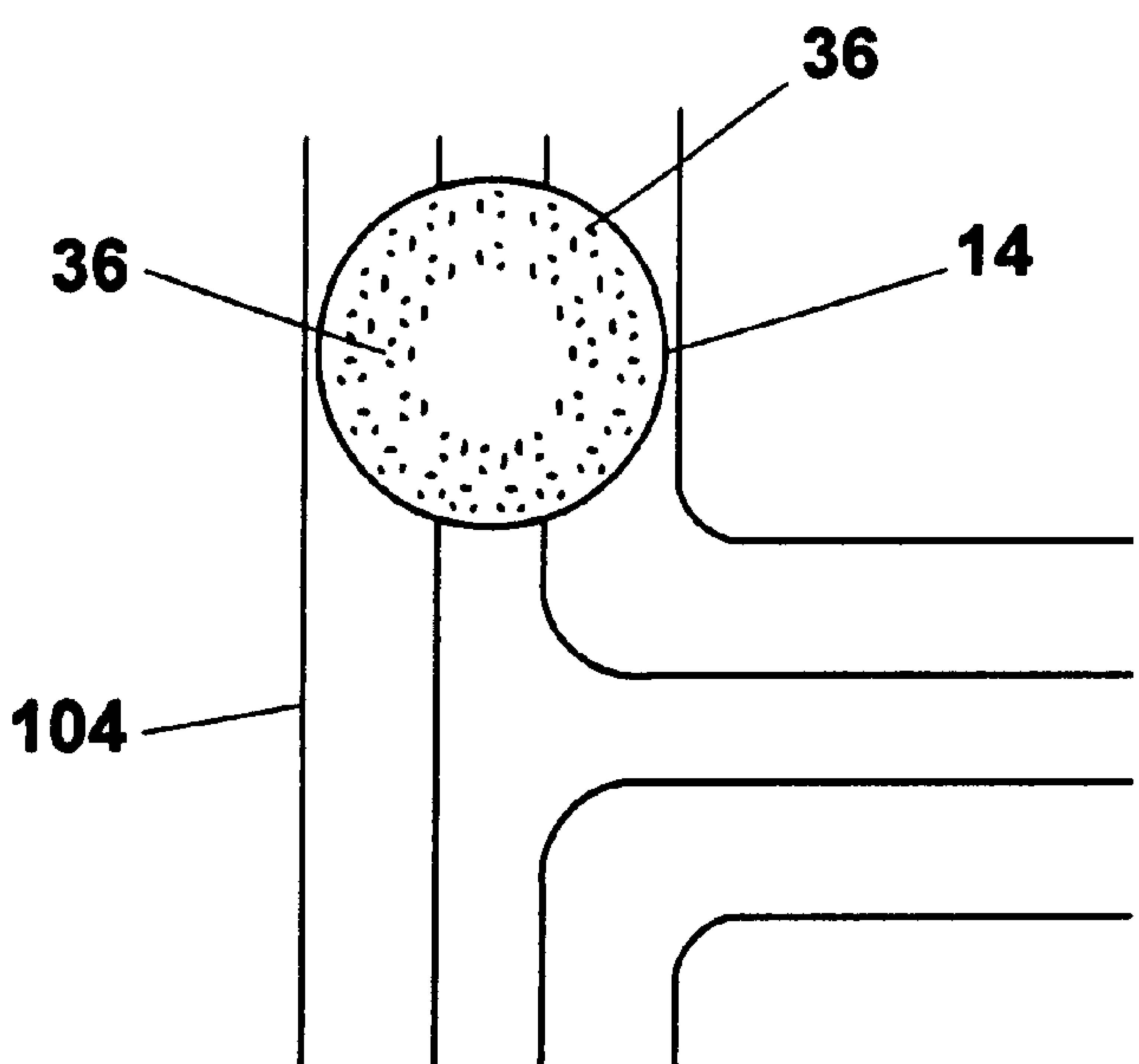


FIG. 13B

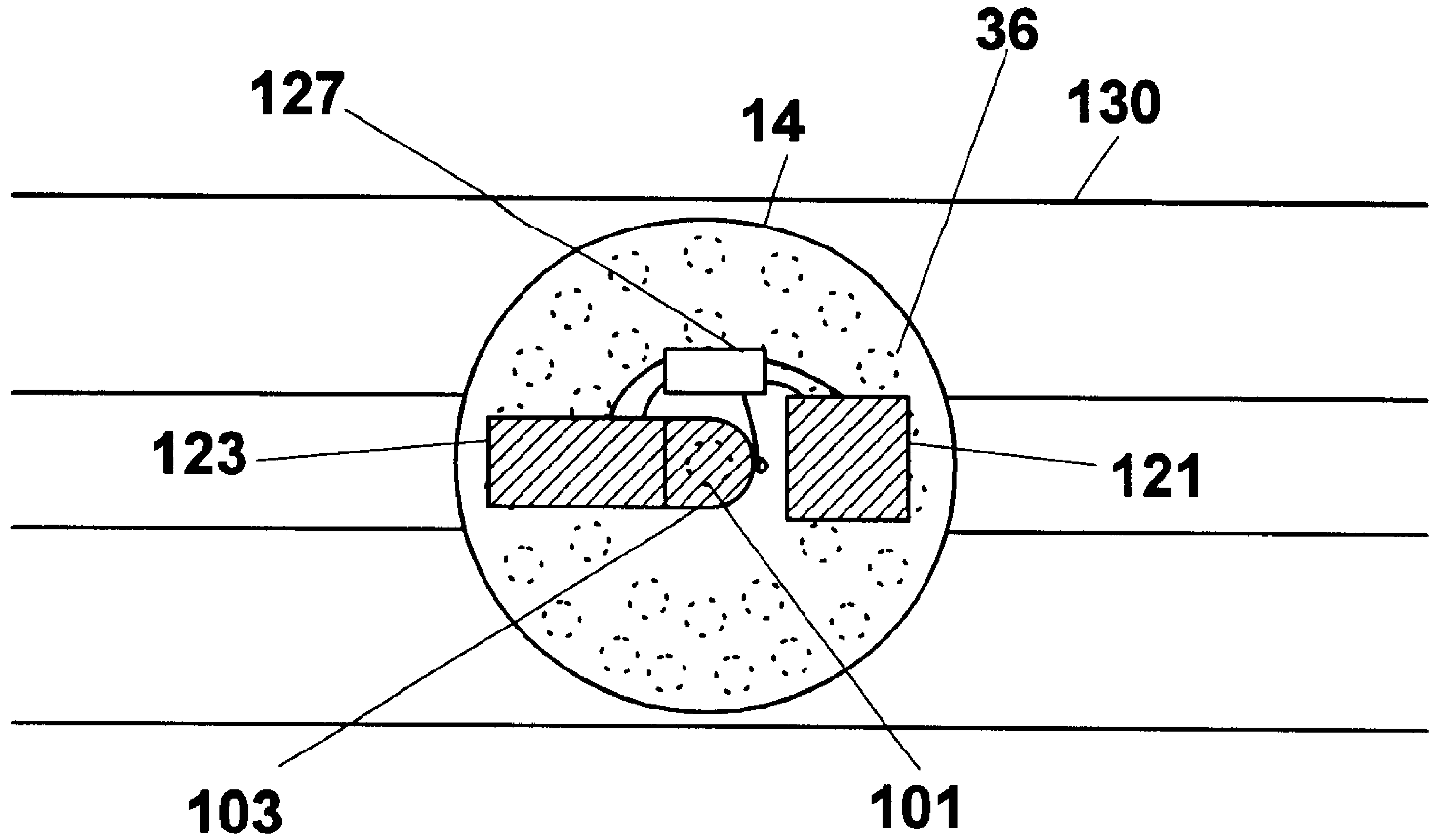


FIG. 14A

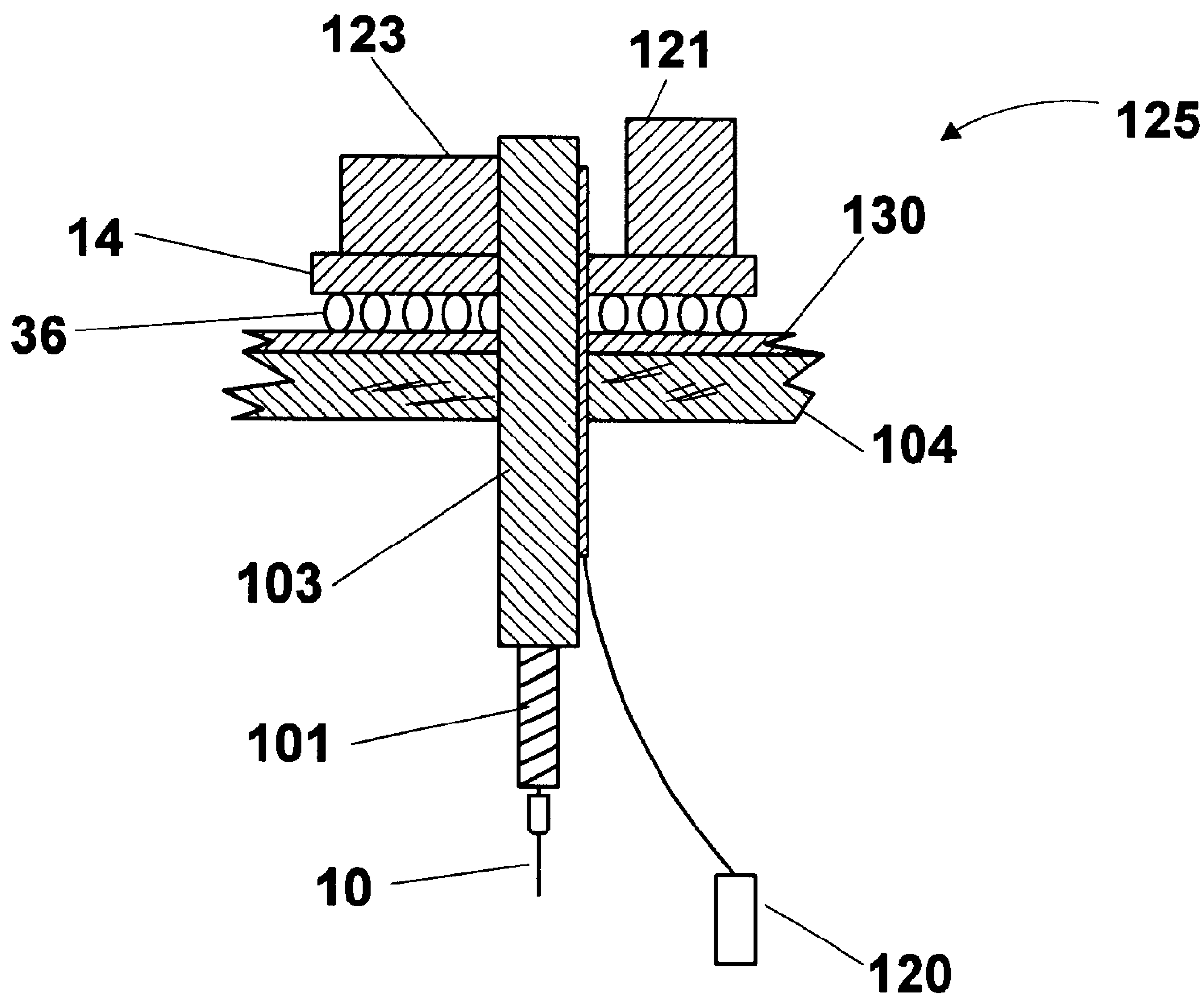


FIG. 14B

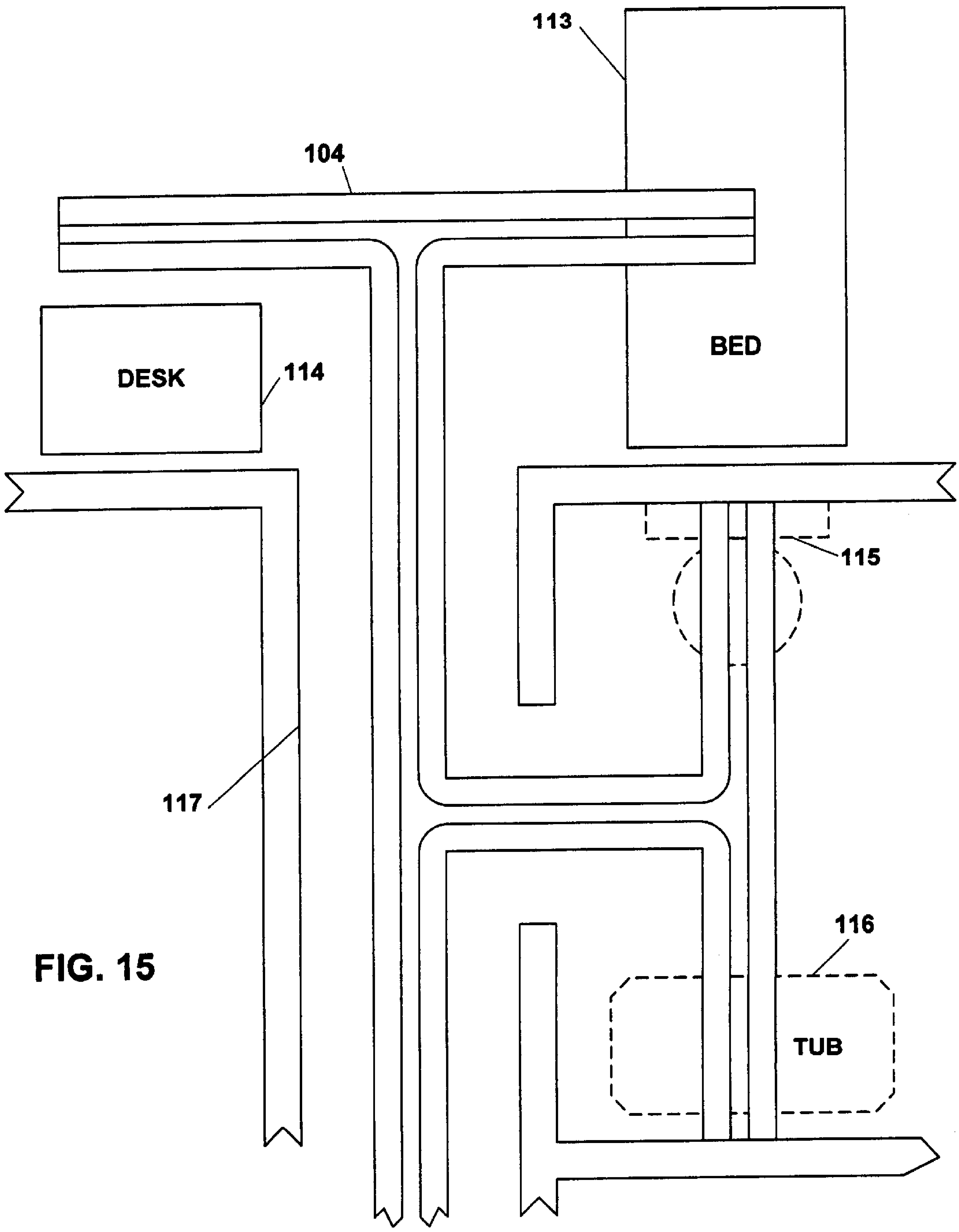


FIG. 15

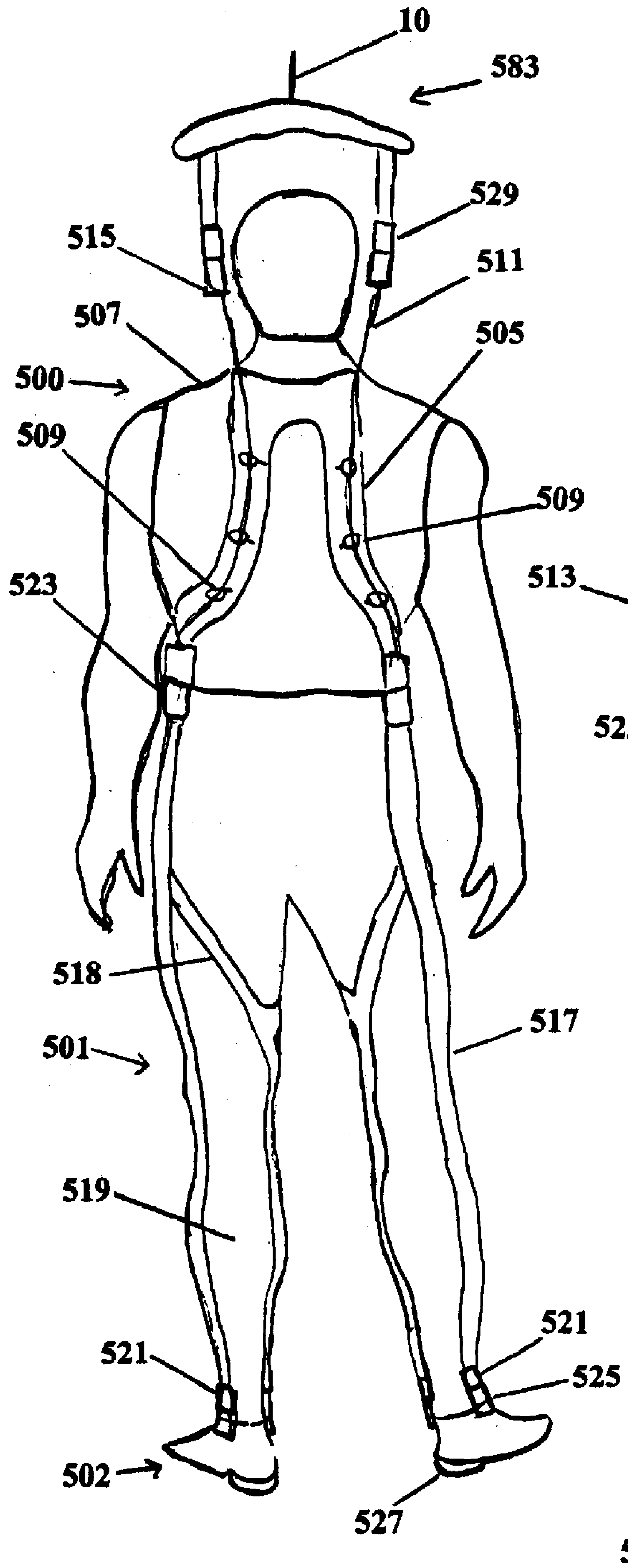

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FIG. 17

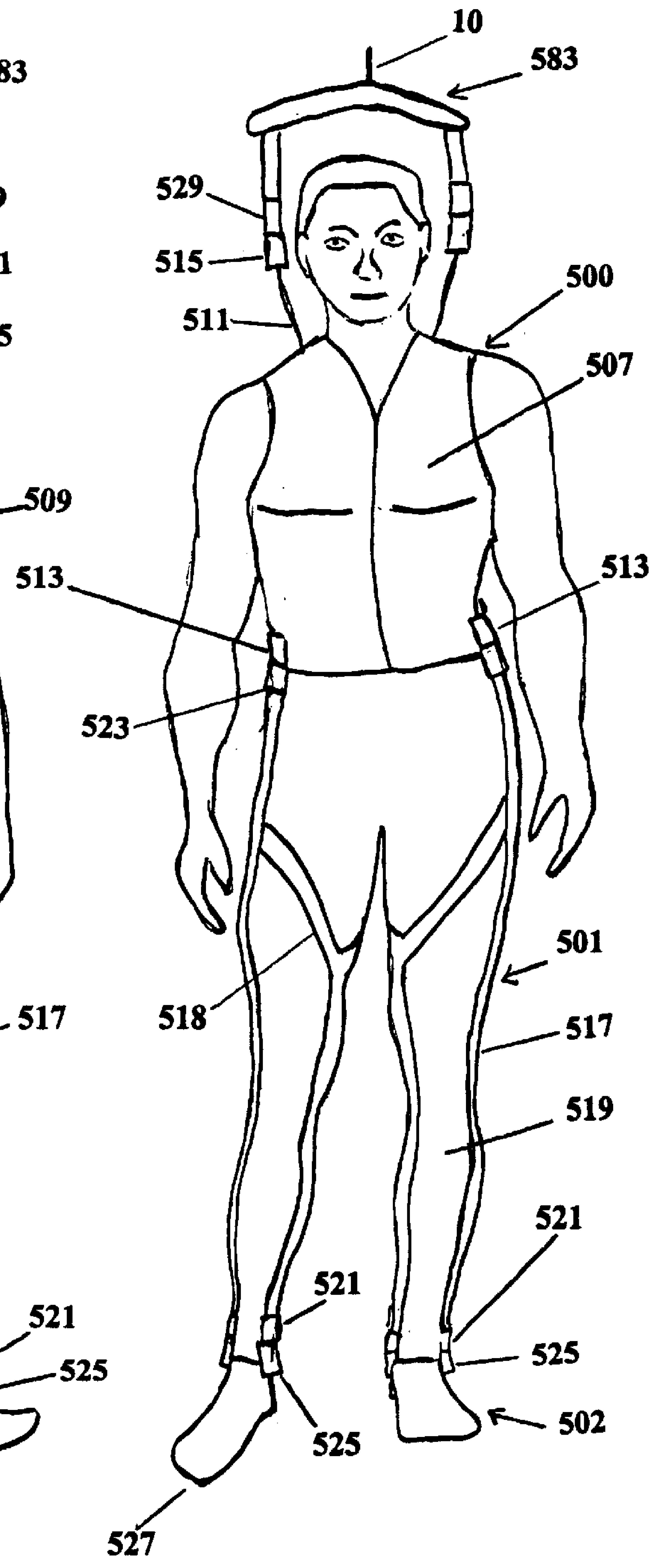
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FIG. 16

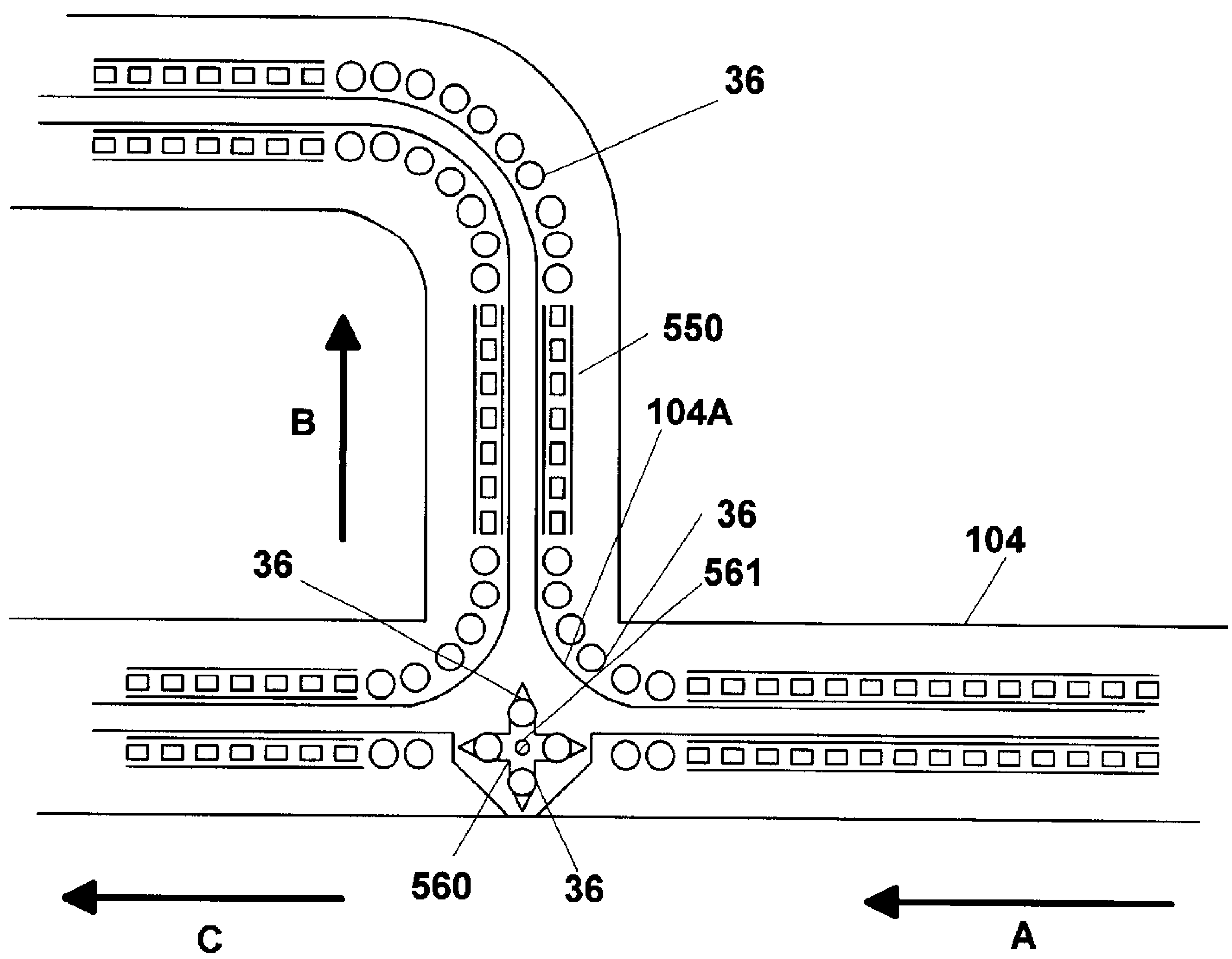

FIG. 20

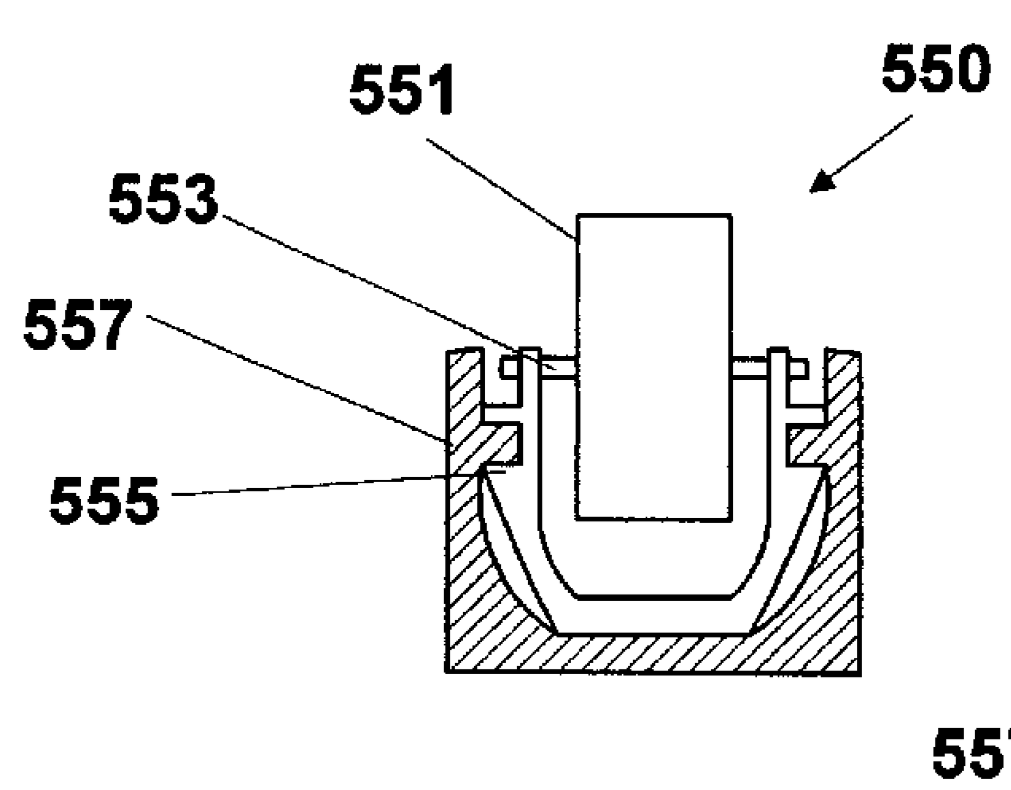

FIG. 18

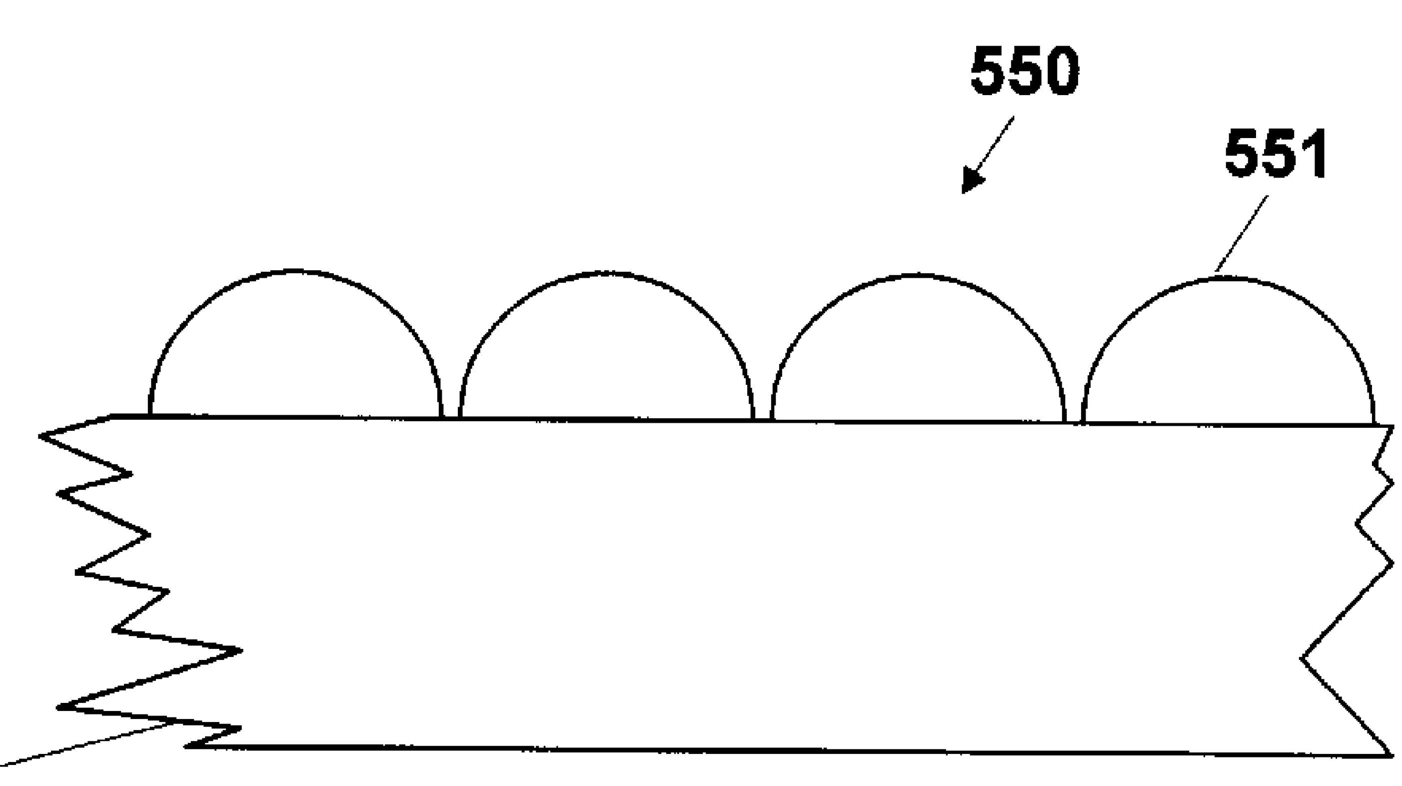

FIG. 19

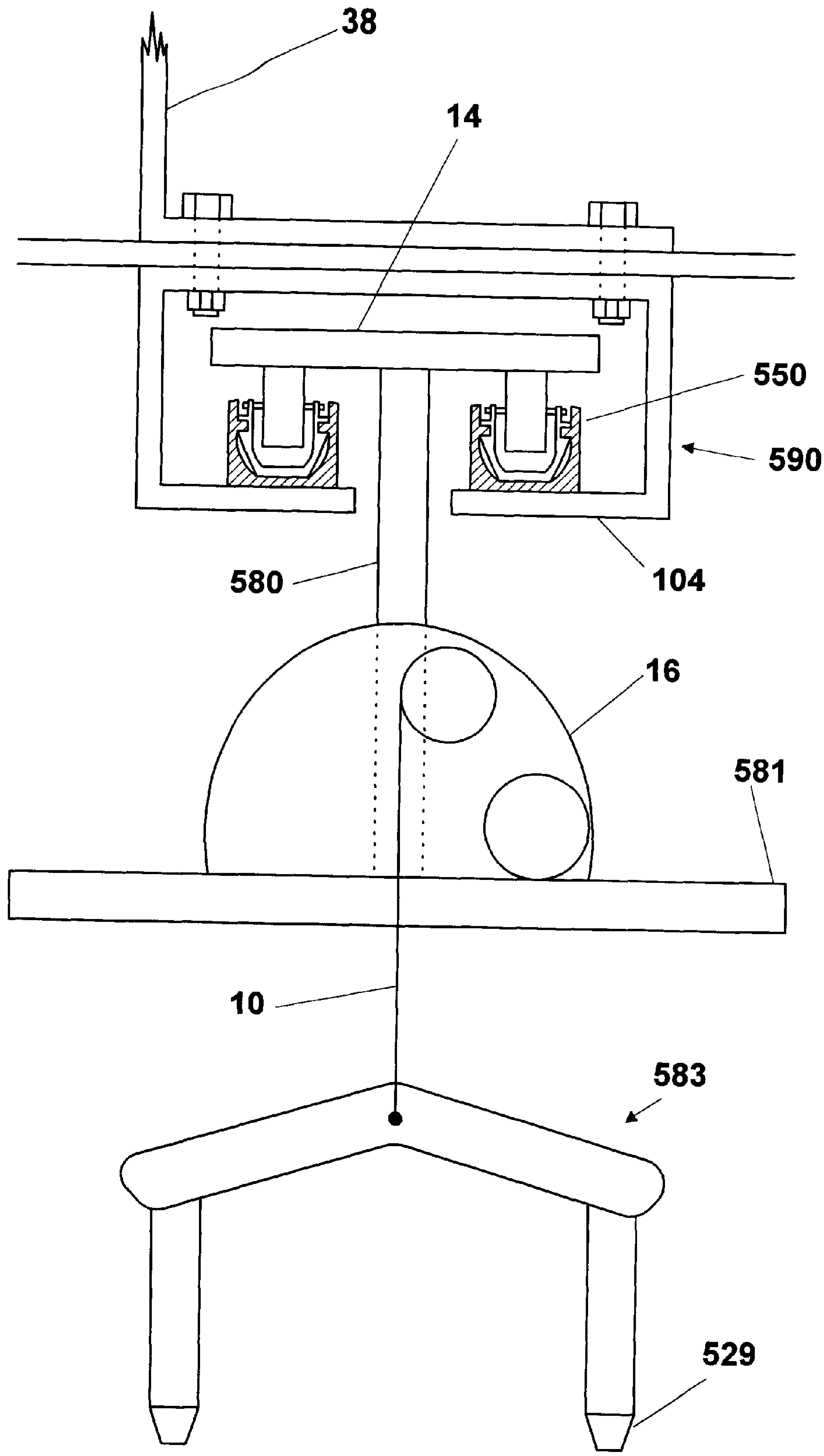

FIG. 21

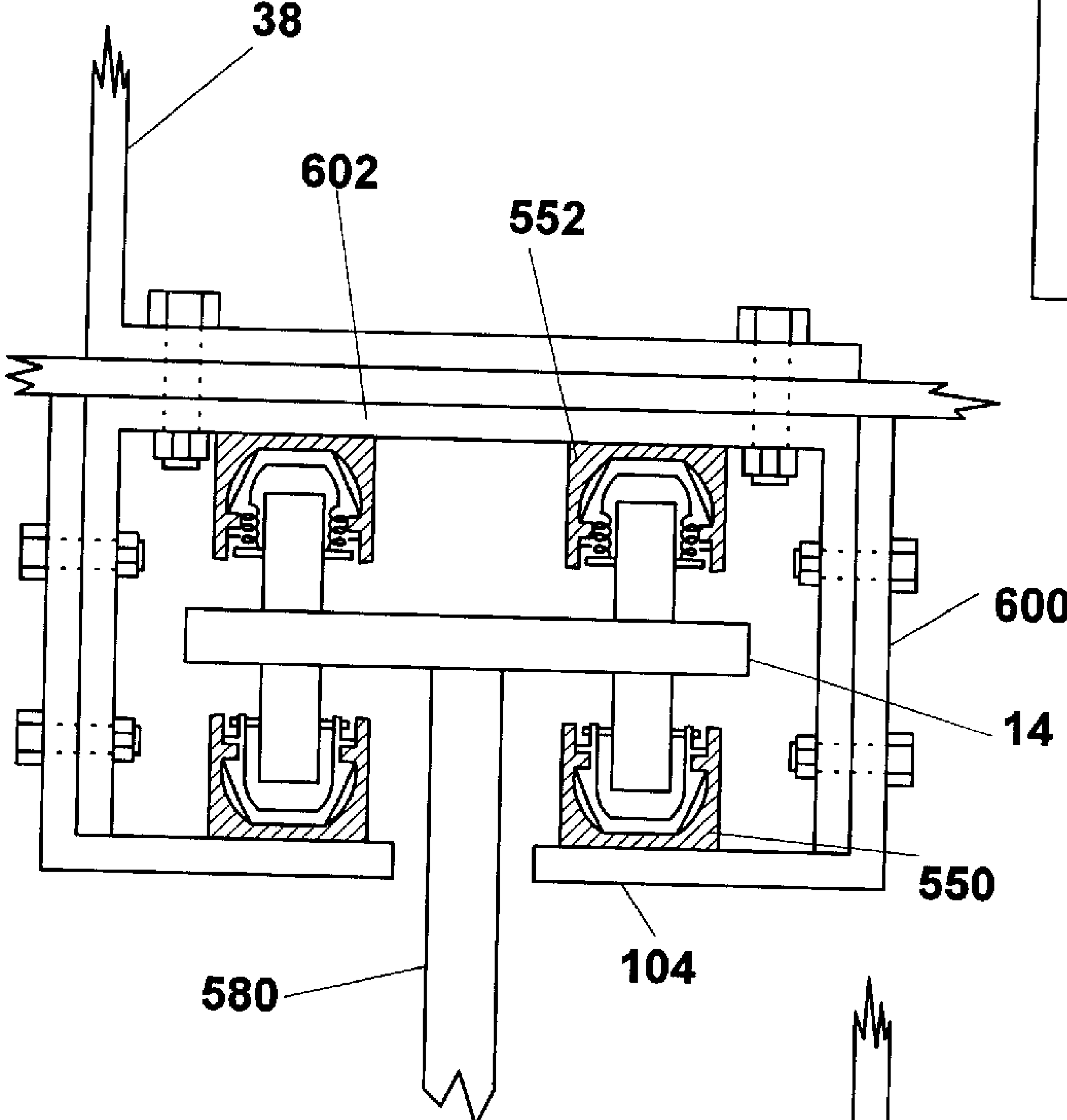

FIG. 22

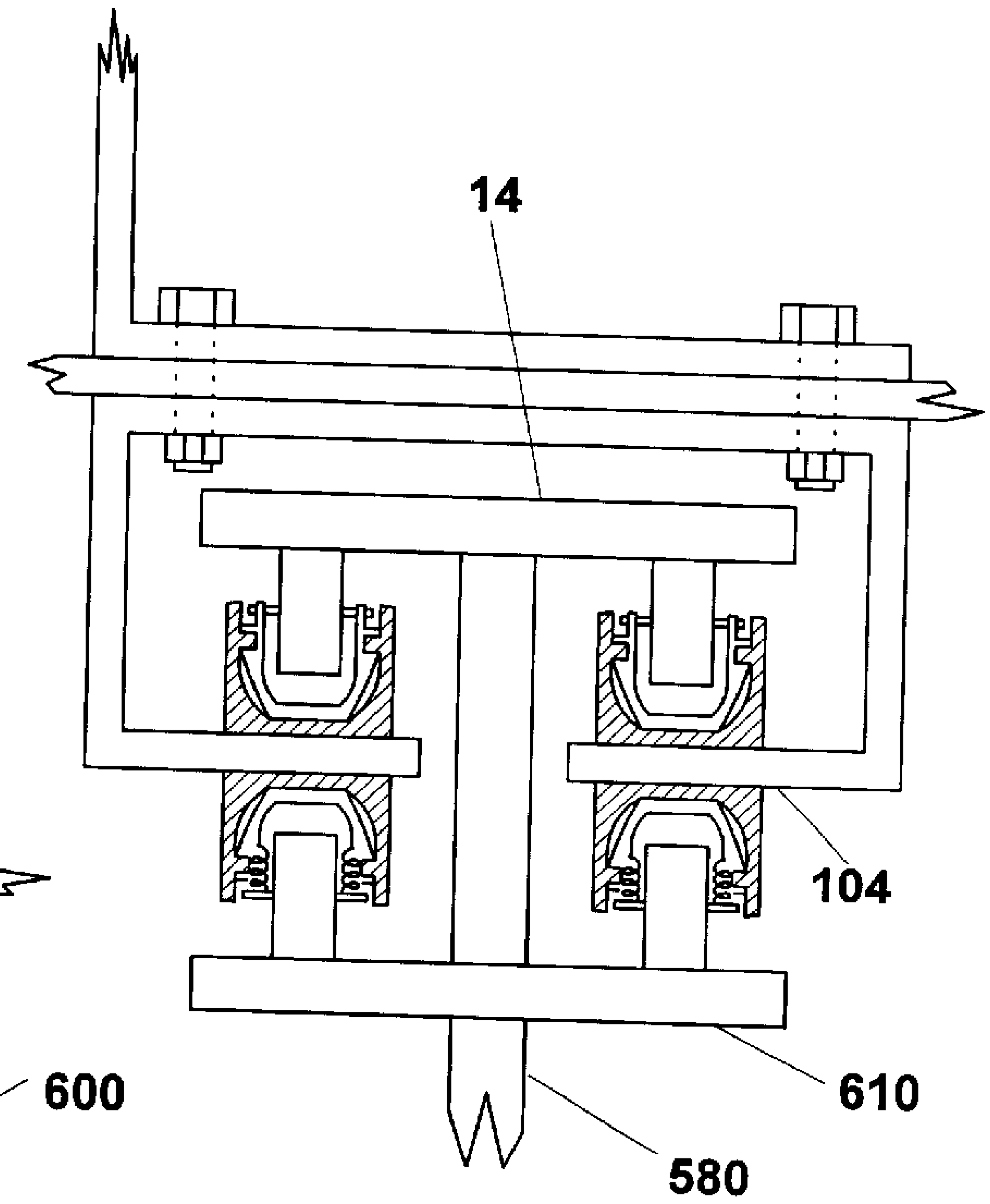

FIG. 23

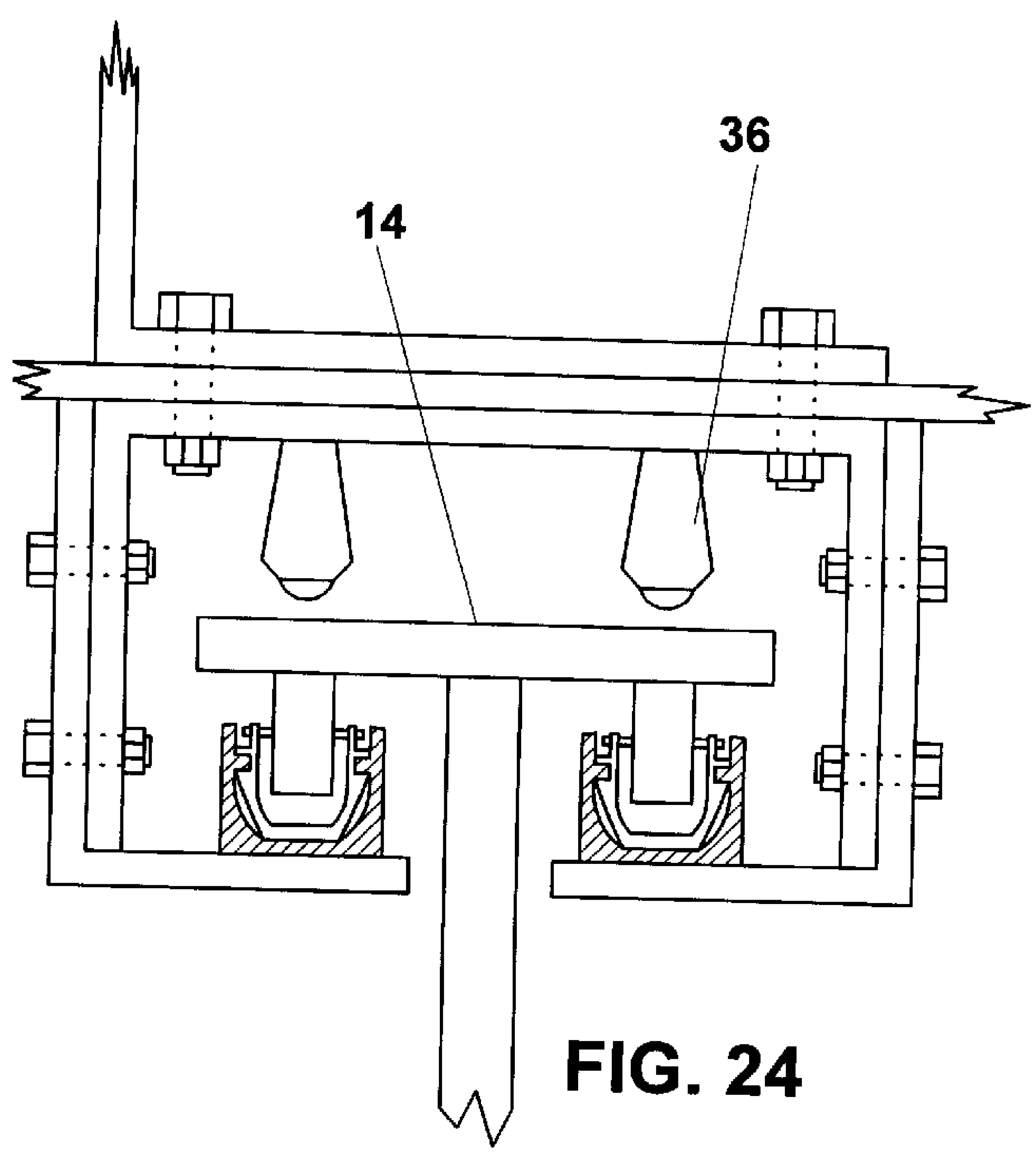

FIG. 24

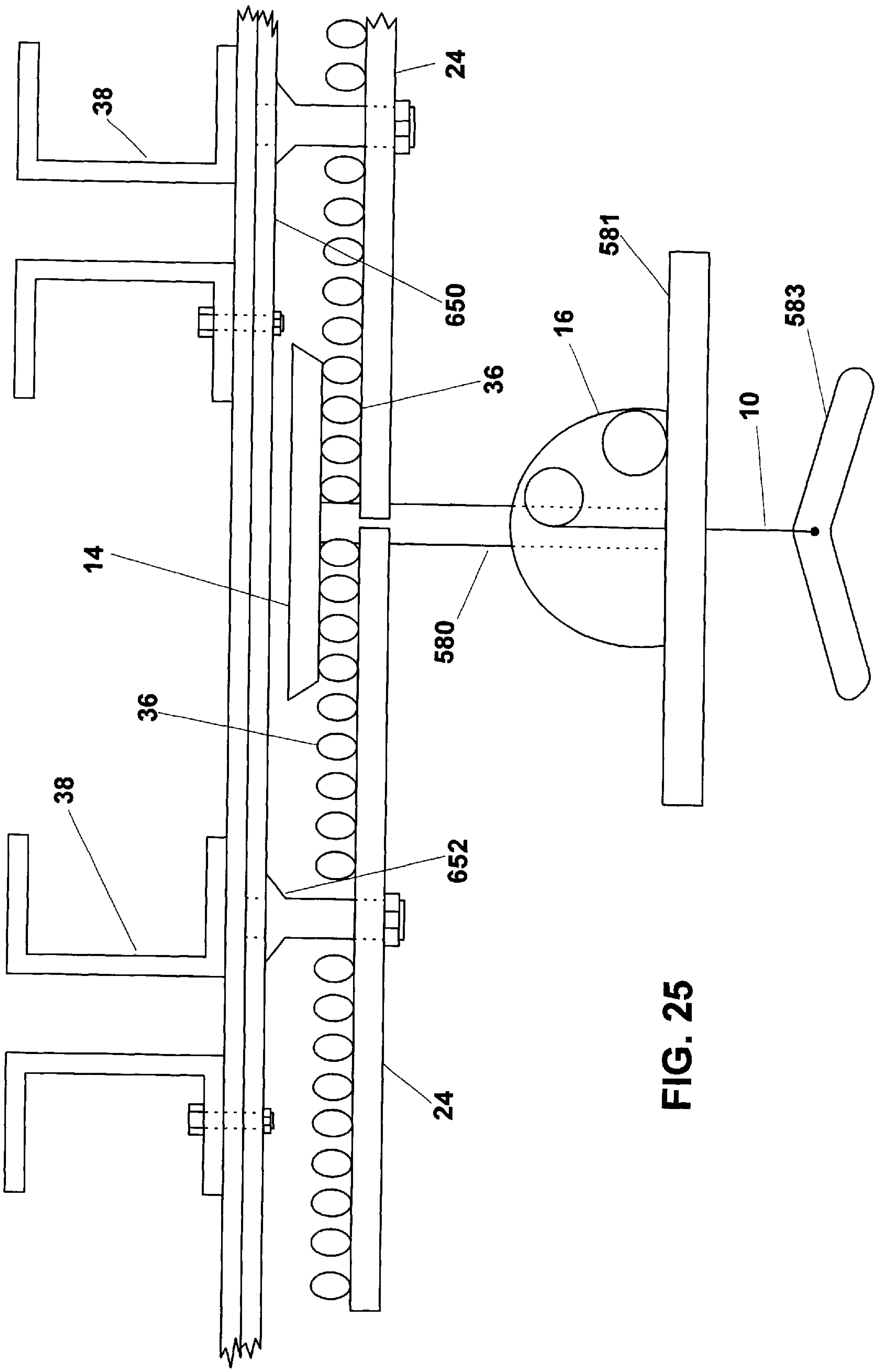

FIG. 25

MULTIDIRECTIONAL, SWITCHLESS OVERHEAD SUPPORT SYSTEM

This application relates to support systems and in particular to overhead support systems. This is a continuation-in-part application of Ser. No. 09/067,079 filed Apr. 27, 1998 now U.S. Pat. No. 5,996,823 and Ser. No. 09/135,380 filed Aug. 17, 1998, now U.S. Pat. No. 6,079,578.

BACKGROUND OF THE INVETION

A significant portion of the population of the world has great difficulty in walking. A huge number cannot walk at all. These groups are forced to rely on attendants or mechanical devices such as crutches or wheelchairs for their ambulation. Included are those with ambulation problems due to recent hip and knee replacement surgery.

When a person is not able to walk for a period of several weeks or months, his leg muscles tend to degenerate unless physical therapy is provided. If the leg muscles degenerate, extensive physical therapy may be required to enable him to regain his ability to walk. Many people never walk again after an extensive period of relying on a wheel chair for transportation.

The prior art includes overhead support systems. These typically include an overhead track with some type of cart riding on the track with a load (which could be a person) suspended from the cart through a suspension tether. Many such systems exist in automated factories. A typical prior art overhead transport system is found by reference to U.S. Pat. No. 5,404,992. This reference discloses a suspension conveyor system comprising a conveyor device that rolls along a track rail. A major disadvantage of this design, and others like it, is that when tracks intersect, the user must select which track to take by a switching means. The switching means tends to be complicated, costly and subject to failure.

Automatic tensioning assemblies are commonly found in prior art overhead transportation systems. Generally, a tensioning assembly will maintain a set load under tension based on the load cell read-out from the torque on the tensioning assembly's drive motor. Usually, a hand held remote is used to set the load, and raise and lower the object being carried by the transportation system.

What is needed is a better overhead support system that allows for movement between intersecting tracks without switches.

SUMMARY OF THE INVENTION

The present invention provides an overhead support system. A riding surface is located over a space and supports at least one overhead cart from which a load is supported by a tension element. A plurality of spherical elements are positioned between the riding surface and overhead cart and are attached to either the cart or the riding surface. The load can be moved horizontally in the space by applying a horizontal force to the load causing the cart to move over the riding surface while carrying the load in the horizontal direction. In preferred embodiments the riding surface is an array of spoked rimless wheels. In other preferred embodiments the riding surface is a slot track, or the riding surface may be a combination of the array and slot tracks. In other preferred embodiments a hoist assembly is used to raise and lower the load. In a preferred embodiment the hoist assembly is located below the riding surface. In another preferred embodiment, the hoist assembly is located above the riding surface. In preferred embodiments casters are mounted on the top of the riding surface to permit easy horizontal

movement of the cart over the casters. In other preferred embodiments the riding surface is flat and casters are mounted on the bottom of the overhead cart.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1A** shows a first preferred embodiment of the present invention.

FIGS. **1B–1E** shows the vertical support rod fastened to the channel shaped beams.

FIG. **1F** shows the channel shaped beams connected to the perimeter beam.

FIG. **2A** shows an array of daisy wheels.

FIG. **2B** is a top view of a single daisy wheel.

FIGS. **3A–3B** shows a second preferred embodiment of the present invention.

FIG. **4A** shows a daisy wheel assembly.

FIG. **4B** is a bottom view of a daisy wheel.

FIG. **5A** shows a third preferred embodiment of the present invention without a motor driven tensioning assembly.

FIG. **5B** shows a third preferred embodiment of the present invention with a motor driven tensioning assembly.

FIG. **6** shows an alternate design of a daisy wheel.

FIGS. **7A** and **7B** show views of a daisy wheel with telescoping spokes.

FIG. **8** shows a fourth preferred embodiment of the present invention.

FIGS. **9A** and **9B** show the top cart, center hole cart and daisy wheel.

FIG. **10** shows a fifth preferred embodiment of the present invention.

FIGS. **11A** and **11B** show the use of the present invention with a slot track embodiment.

FIGS. **12A** and **12B** show a cross-section view of a slot track embodiment.

FIGS. **13A** and **13B** show the overhead cart on top of the slot track.

FIGS. **14A** and **14B** show an alternate hoist assembly.

FIG. **15** shows a slot track installed to reach different locations in a residence.

FIGS. **16** and **17** show a user wearing an alternate harness assembly.

FIGS. **18** and **19** show a rolling wheel assembly.

FIG. **20** shows another preferred embodiment of a slot track.

FIG. **21** shows a preferred embodiment where the hoist assembly is located below the slot track

FIGS. **22–24** show other preferred embodiments where the hoist assembly is located below the slot track

FIG. **25** shows a preferred embodiment where the hoist assembly is located below the array of daisy wheels.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the present invention can be described by reference to the drawings.

First Preferred Embodiment

A first preferred embodiment of the present invention can be described by reference to FIGS. **1A** through **4B**. As shown in FIG. **1A**, a person **2** is partially supported by overhead support system **4**. This system is installed near the ceiling of a small room (specifically, in this particular embodiment, about 8 feet [100.25 inches] by about 9.5 feet [114.50 inches]). The person **2** wears a parachute type harness **6** to which is attached curved support bar **8** which is in turn attached to support cable **10**. Support cable **10** passes through cart tube **12**, which is an integral part of overhead cart **14**.

The small room depicted in FIG. **1**A and also in FIG. **2**A is outfitted with thirty-three daisy wheels **24** as shown in FIGS. **2**A and **2**B. The thirty-three daisy wheels **24** define the riding surface upon which overhead cart **14** rides. A daisy wheel assembly is shown in FIG. **4**A. A top view of one daisy wheel **24** is shown in FIG. **2**B. Each daisy wheel **24** is comprised of an approximately circular inner frame **26** having a 6-inch diameter and **16** 5-inch spokes **28** to produce a daisy wheel diameter of 16 inches. Each daisy wheel **24** is rotationally mounted on an 18-inch 1-inch diameter steel support rod **30**. Easy rotation is provided with a bushing type bearing **32** as shown in FIG. **4**A. The daisy wheel in this embodiment is comprised of a laminated structure with a 2-inch thick wood core **24**A with 0.1-inch steel plates **24**B on top and bottom as shown in FIG. **4**. Other materials such as aluminum, steel or fiber plastic may be used. In this embodiment spokes **28** are petal shaped as shown in FIG. **2**B and all **16** of them together define sixteen 2-inch slots **34** as also shown in FIG. **2**B. Mounted on top of daisy wheel **24** are thirty-six casters **36**, as shown in FIGS. **1**A and **2**B. These are inexpensive commercially available casters each having an 11/16-diameter roller ball mounted in a metal frame with the roller ball riding on three smaller ball bearings. The roller ball and the ball bearings and frame are supported by a threaded bolt which is used to attached the caster to daisy wheel **24**. These casters are available from suppliers such as Acme Caster Company with offices in Paughkeepsee, N.Y.

Each 18-inch steel rod **30** is attached to one of eleven 8-foot overhead beams **38**. Channel shaped beams **38** holding steel rods **30** are fitted with V-wedge blocks welded in a vertical position on the back side of horizontal beams **38** as shown in FIG. **1**E and spaced to the pitch of the daisy wheels, as shown in FIG. **2**A. Two channels are bolted together with bolts **35** and steel rods **30** are held by V-wedges **31** in a vertical position, as shown in FIG. **1**D. V-wedge **31** spacing alternates with each adjoining beam **38** to form a triangular pitch of rods **30**. Channel beams **38** (2 channels back-to-back) are supported at the edge of the room by a single perimeter channel **37** attached to wall studs, as shown in FIG. **1**C. Clip angles **62** are used to attach channel shaped beams **38** to perimeter channel **37**, as shown in FIG. **1**F.

In this embodiment, the bottom surface of overhead cart is flat and rides on casters **36** mounted on the thirty-three daisy wheels **24** and shelves **40** and circular supports **42**, as shown in FIGS. **1**A and **2**A.

Person **2** shown in FIG. **1**A is supported by overhead support system and, with minimal stress, he can walk about in the room. Person **2** is free to go anywhere in the room except directly below the center of each daisy wheel. Preferably the overhead support system would extend at least from the persons bed to his bathroom and his eating area. This would permit him to be relatively independent. The reader should note that person **2** might sit down in a chair or lie down in a bed while continuing to be supported by overhead support system **2** provided the chair or bed is at a desired height, and more than one person could be supported by overhead support system **4**. In fact in a retirement or medical facility with many patients, a large number of persons could be using the system simultaneously.

Second Preferred Embodiment

A second preferred embodiment can be described by reference to FIGS. **3**A and **3**B. The system is similar to the first preferred embodiment described above except this embodiment comprises a motor driven hoist assembly **16**. Mounted on overhead cart **14** is hoist assembly **16**, which is programmed to provide a constant tension on support cable **10**. In a preferred embodiment that tension is 100 pounds (with capacity for 500 lbs.). Hoist assembly **16** is shown in more detail in FIG. **3**B and comprises take-up axis **20** and drive motor **18**, which is powered by rechargeable battery **21**. Hoist assembly **16** is capable of raising and lowering support cable **10** from 14 inches to 72 inches.

Hoist assembly **16** is controlled by a set load based on load cell read-out from torque on drive motor **18**. A hand held remote control unit is used to set load, raise or lower cable **10**.

With hoist assembly **16**, person **2** shown in FIG. **1**A who (for example) weighs 150 pounds is now receiving 100 pounds of support from overhead transportation system **2**. This person's own legs now have to support only 50 pounds. Thus, with minimal stress person **2** can walk about in the room. Person **2** is free to go anywhere in the room except directly below the center of each daisy wheel. Of course, the tension on support cable **10** can be adjusted to any value up to the weight of person **2**. Recommended tensions would vary from about 90 percent of the person's weight to about 20 percent of the person's weight. Preferably the overhead support system would extend at least from the persons bed to his bathroom and his eating area. This would permit him to be relatively independent. It should be noted that person **2** might sit down in a chair or lie down in a bed while continuing to be supported by overhead support system **2**. Hoist assembly **16** automatically extends support cable **10** to permit sitting or lying down. This embodiment also includes a hand-held remote control unit and a detector mounted on tube **12** with which person **2** can de-energize hoist assembly **16** or change the tension applied by it. It should be noted that more than one person could be supported by overhead support system **4**. In fact in a retirement or medical facility with many patients, a large number of persons could be using the system simultaneously.

Third Preferred Embodiment

A third preferred embodiment of the present invention may be described by reference to FIGS. **5**A and **5**B. This embodiment is exactly the same as the first embodiment except in this case the Casters **36** are mounted on the bottom of cart **12**A and the tops of the daisy wheels **24** the shelves **40** and circular wheels **42** are flat, with no casters **36**.

Star Shaped Spoked Wheels

Another preferred embodiment, especially useful if casters **36** are mounted on the spoked wheel is to utilize a spoked wheel in the general shape of an ornamental star (or spider) as shown in FIG. **6**. The points (or legs) of the star can be generally straight or angled as shown in FIG. **6**. The angled shape of the legs encourages rotary motion of the spoked wheels as the cart is moved above the wheels.

Other Daisy Wheel Designs

Many modifications to the basic daisy wheel design described above could be made. Other bearing arrangements would work. For example ball bearings instead of bushing type bearings could be used. The daisy wheel part of the daisy wheel assembly could be rigidly attached to support rod **30** and a bearing arrangement mounted at the top of rod **30** could permit rotation of rod **30** along with daisy wheel **24**. The spokes of daisy wheel **24** could be offset from radial directions as shown in FIG. **6**. It is believed that this design would tend to guide the cart around a support when a person is headed straight toward it. The spokes of daisy wheel **24** could be designed to telescope in and out as the daisy wheel rotates in order to substantially fill the ceiling space. Such a design is shown in FIGS. **7**A and **7**B. This feature substantially complicates the design of the daisy wheel but would permit use of carts with smaller bottom surface areas. Applicant refers to the daisy wheel array shown in FIG. **1**A as a triangular array. Other arrays are possible, such as a rectangular array. However, the rectangular array produces more open space for the cart to cross.

Design Parameters

Preferably the support system for use to support people is designed to withstand a dynamic load of at least 1000 pounds, preferably 2000 pounds. Users should be able to move through the room at speeds of at least 30 feet per minute. The Tether system should be able to lift a person from a prone position on the floor to a full standing position. The support system should be modular in design to fit rooms from 30 square feet to 200 square feet of various widths and lengths. Several people should be able to use the system simultaneously. The system should allow two persons to pass in a four-foot wide hallway. The system should be easy to install (for example) in a 200 square foot room by two people in about 4 hours. In the above embodiment the maximum deflection of the tips of the daisy wheels is estimated to be about 1⁄32 inch with a 300 pound load.

Other Cart Designs

Various other cart designs are possible. For example, in some applications a hoist may not be needed or could be located below daisy wheels **24**. With the hoist eliminated or located beneath the daisy wheels **24**, the distance between the daisy wheels **24** and channel shaped beams **38** can be lessened, or a double layered cart as shown in FIG. **8** could be used. In FIG. **8**, casters **36** roll in-between daisy wheels **24**, center hole cart **58** and top cart **57**. Also, casters **36** roll between top cart **57** and false ceiling **60** for greater stability. FIGS. **9**A and **9**B further illustrate the function of top cart **57** and center hole cart **58** with the hoist part of hoist assembly **16** eliminated from above daisy wheel **24**. Cart tube **12** is rigidly connected to top cart **57**. Casters **36** are fastened to the bottom of top cart **57** and roll on center hole cart **58**. Because center hole cart **58** contains a hole **58**A, top cart **57** is able to achieve greater motion along center hole cart **58** than it could if there was no hole **58**A. Center hole cart **58** rides on casters **36** attached to the topside of daisy wheel **24**.

FIG. **10** shows center hole cart **58** with casters **36** attached to its bottom side. However, there are no casters in-between center hole cart **58** and top cart **59**. A further modification of this design would be to remove casters **36** from in-between daisy wheel **24** and center hole cart **58**. For this embodiment low friction material and/or appropriate lubricants could be utilized.

In other embodiments, the carts can be equipped with a prior art track attachment to permit a person using the system to exit a room equipped with the present invention and proceed to a room, hallway or stairway equipped with an overhead track system. The track system could be motorized, especially for stairways. For multi-story buildings an elevator can be equipped with the spoked rimless wheels in the ceiling of the elevator to permit persons to move from one floor to a higher or lower floor.

Slot Track Embodiment

Previous discussion has focused the utilization of the present invention in a room with an array of daisy wheels **24**, as shown in FIG. **2**A. In other words, daisy wheels **24** provided the riding surface for overhead cart **14**. However, it is also possible, and in many cases desirable, to have a slot track as the riding surface. The slot track embodiment is described by reference to FIGS. **11**A through **15**. The advantage of using a slot track over a prior art track is that prior art tracks require the user to operate a switching means in order select which track to take whenever tracks intersect. The switching means tends to be complicated, costly and subject to failure. Also, as previously stated, to integrate the present invention with a prior art track would require fitting the overhead carts with a prior art track attachment, which would raise both the cost and weight of the present invention.

A first embodiment of the slot track version of the present invention is shown in FIG. **12**A (side view) and FIG. **13**A (top view). In FIG. **11**A, person **2** is shown using the embodiment shown in FIGS. **12**A and **13**A. FIG. **11** A shows overhead cart **14** rolling on casters **36**. In this embodiment, casters **36** are mounted on both sides of slot track **104**, as shown in FIGS. **12**A and **13**A. In the preferred embodiment, casters **36** are spaced 2 inches apart.

As shown in cross section view presented by FIGS. **12**A and **12**B, slot track **104** has a slot that is four inches wide and which is bordered one each side by plywood planks **104**A and **104**B that have a thickness of two inches. The length of the planks will vary depending on the length of the slot track desired. Slot track **104** is supported horizontally by 2-inch×4-inch boards **105** rigidly attached to slot track **104** and rigidly attached to wall studs **106**. Slot track **104** is supported vertically by rigid attachment to 2-inch×4-inch boards **107**, which in turn are rigidly attached to track support boards **108**, which are in turn rigidly attached to 2-inch×4-inch boards **109**, which are in turn rigidly attached to joists **110**. In the preferred embodiment, boards **105** and **109** are rigidly attached to wall studs **106** and joists **110**, respectively, by screws which can easily be screwed through dry wall **111** and ceiling **112**.

The main advantage of slot track **104** is made clear by reference to FIG. **13**A and FIG. **15**. FIG. **13**A shows casters **36** mounted on the edge of slot track **104**. Overhead cart **14** can proceed straight or turn, depending on the will of the user. Response is instantaneous and no switching mechanisms are required, unlike prior art systems. FIG. **15** better illustrates how the present embodiment could be utilized in a residence. Slot track **14** could be installed to allow movement between bed **113**, desk **114**, toilet **115**, tub **116** and down the hallway **117**. As previously stated, no switching mechanisms would be required at slot track intersections.

Slot Track Embodiment with Casters Mounted on Overhead Cart

The slot track embodiment described above shows casters **36** mounted on slot track **104** and spaced 2 inches apart. However, it is also possible to mount casters **36** on overhead cart **14** and so that casters **36** roll on a smooth slot track, as shown in FIGS. **11**B, **12**B and **13**B. The obvious advantage of this embodiment is that fewer casters are necessary and consequently, there is a tremendous financial savings.

Noise Dampening

As overhead cart **14** is moved, casters **36** roll. Unfortunately, the rolling can be very noisy. It is, however, possible to dampen this unpleasant sound. Noise abatement material **130** can be placed in-between casters **36** and the opposing surface. For example, as shown in FIGS. **12**B and **14**B noise abatement material **130** is glued to the top of slot track **104**. It would also be possible to glue noise abatement material to the tops of daisy wheels **24**. Conversely, it is possible to glue noise abatement material **130** to the bottom of overhead cart **14** in embodiments that have casters **36** attached to the sides of slot track **104** or the tops of daisy wheels **24**. In a preferred embodiment, noise abatement material is made from polyurethane, part no. 8716K82. It is supplied by McMaster-Carr Supply Company with offices in Sante Fe Springs, Calif.

Combining the Slot Track Riding Surface with the Daisy Wheel Riding Surface Another preferred embodiment is to combine in a single facility a slot track embodiment with an array of daisy wheels embodiment. For example, a residence could have a slot track configuration as described in FIG. **15** that takes the user through the hallway and selected rooms. Slot track **104** could also then take the user to a different room configured, such as the room shown in FIG. **2**A, with an array of daisy wheels. An example of a room that might be set up with the daisy wheel array, would be a living room where the ability to move in random directions is more important than a hallway or a bathroom.

Using Rolling Wheel Assemblies at Slot Track Straight Sections

FIG. **18** shows a front view of rolling wheel assembly **550**. Wheel **551** rotates on axis **553**, which is supported by bracket **555**. Bracket **555** slides into assembly track **557**. As more brackets **555** are slid onto assembly track **557**, a series of wheels **551** is formed, as shown in FIG. **19**. Wheels **551** and brackets **555** are sold together as one unit and are available from McMaster/Carr Supply Co., in Los Angeles, Calif. (part no. 5897K41). Assembly track **557** is also available from McMaster/Carr Supply Co. (part no. 5897K71)

FIG. **20** shows a top view of slot track **104**. In this embodiment, rolling wheel assemblies **550** are placed along the straight sections of slot track **104**. Casters **36** are placed along the curved sections of slot track **104** and at where slot tracks **104** intersect. The advantages of using rolling wheel assemblies **550** at the straight sections of slot track **104** are that they are less expensive than casters **36** and that they are much quieter. It is, however, still desirable to use casters **36** at curved sections and at intersections because casters **36** allow overhead cart **14** to move more smoothly around curves and at points where there is a change of direction.

Inserting a Spoked Wheel at Slot Track Intersections

FIG. **20** shows spoked wheel **560** placed at the intersection of two slot tracks **104**. Spoked wheel **560** is free to rotate around the axis formed by overhead support axis **561** If a user is traveling in a direction A and desires to change his direction to direction B at the slot track intersection, it is more natural and more desirable for him to be able to “cut the corner” rather than make a sharp ninety degree turn. Rounding the corner at slot track section **104**A allows the user to “cut the corner”. However, it also opens a relatively large gap in slot track **104** that, if ignored, could permit overhead cart **14** to fall through the slot in slot track **104**. By placing spoked wheel **560** at the intersection, it is possible to round the corners at slot track **104** intersections. Then, if the user, coming from direction A decides to turn right and proceed in direction B, overhead cart **14** will roll on casters along slot track section **104***a* and along the caster position on top of spoked wheel **560**. If the user, coming from direction A decides to proceed straight down direction C, then overhead cart **14** will be supported by the casters on slot track **104**, as well as casters **36** on spoked wheel **560**. Also, spoked wheel **560** will rotate counter-clockwise as overhead cart **14** makes contact.

Placing the Hoist Assembly below the Slot Track

Previous embodiments have described hoist assembly **16** as being placed above slot track **104**. However, it is possible to place hoist assembly **16** below slot track **104**, as shown in FIG. **21**. Extrusion **590** is bolted to overhead beam **38**. Preferably, extrusion **590** is ¼ inch thick single piece ceiling support extrusion (3¾ inch×6½ inch). Rolling wheel assemblies **550** are bolted to the top of slot track **104**. Overhead cart **14** rolls on top of rolling wheel assemblies **550**. Lower lift platform support rod **580** is rigidly connected to overhead cart **14**. Lower lift platform **581** is rigidly connected to platform support rod **580**. Hoist assembly **16** is positioned on top of lower lift platform **581**. Hoist assembly **16** functions to raise or lower cable **10**, which is connected to harness connect assembly **583**.

A major advantage of placing hoist assembly **16** below slot track **104** is that extrusion **590** can be smaller than it would otherwise have to be if hoist assembly **16** was placed above slot track **104**. Another advantage is that slot track **104** can be positioned closer to the ceiling. These advantages result in a more aesthetically pleasing overhead support system, one that is less expensive and also one that is easier to mount.

Other Embodiments Placing the Hoist Assembly below the Slot Track

FIGS. **22–24** show alternate embodiments employing overhead cart **14** stabilizing mechanisms. As shown in FIG. **22**, U-shaped metal extrusion **602** is bolted to overhead beam **38**. L-shaped metal extrusions **600** are bolted to U-shaped metal extrusion **602**. Rolling wheel assemblies **550** are rigidly connected to the top of slot track **104**. Spring loaded rolling wheel assemblies **552** are rigidly connected to the bottom of U-shaped metal extrusion **602**. Overhead cart **14** rolls on rolling wheel assemblies **500** and is stabilized (i.e., prevented from excessive tilting) by spring-loaded rolling wheel assemblies **552**.

FIG. **23** shows lower cart stabilizer platform **610** rigidly connected to lower lift platform support rod **580**. Overhead cart **14** rolls on rolling wheel assemblies **500** and is stabilized by spring-loaded rolling wheel assemblies **552** bearing down on lower cart stabilizer platform **610**.

FIG. **24** shows an embodiment similar to that shown in FIG. **22** with the exception that casters **36** replace spring-loaded rolling wheel assemblies **552**. Overhead cart **14** rolls on rolling wheel assemblies **500** and is stabilized by casters **36**.

Placing the Hoist Assembly below the Daisy Wheels

FIG. **25** shows an embodiment that places hoist assembly **16** below the array of daisy wheels **24**. One piece ceiling support extrusion **650** is bolted to overhead beams **38**.

Preferably, ceiling support extrusion **650** is metal and is approximately ½ inch thick and 3 inches deep. Daisy wheel support posts **652** are threaded into ceiling support extrusion **650**. An array of daisy wheels **24** are then bolted to daisy wheel support posts **652**. Overhead cart **14** rolls on casters **36** and lower lift platform **581** supports hoist assembly **16** below the array of daisy wheels **24**.

A major advantage of this embodiment is that it is much easier and to install and less expensive then the earlier described daisy wheel embodiments. Another advantage is that because daisy wheel support posts **652** are much shorter than steel support rod **30** (FIG. **3A**), there is far less chance of daisy wheel **24** tilting due to the weight of the support system and the user.

Alternate Hoist Assembly

An alternate hoist assembly **125** is described by reference to FIGS. **14A** and **14B**. Support cable **10** is connected to geared lifting rod **101**. Geared lifting rod **101** is meshed inside support tube **103**. Support tube **103** is rigidly connected to cart motor **123**. Cart motor **123** and power source **121** are rigidly connected to overhead cart **14**. Cart motor **123** is connected to geared lifting rod **101**. Hand control unit **120** is electrically connected to controller **127**. Controller **127** is also electrically connected to power source **121** and cart motor **123**. In the preferred embodiment, power source **121** is a 12-volt DC dry cell battery rated at 22 Amps.

FIGS. **11A** and **11B** show person **2** operating hand control unit **120**. As shown in FIGS. **14A** and **14B**, hand control unit **120** provides an electrical signal to controller **127**. Controller **127** directs power from power source **121** to cart motor **123**. Cart motor **123** then turns geared lifting rod **101** either clockwise or counterclockwise, depending on whether person **2** desires to be raised or lowered.

In a preferred embodiment, hoist assembly **125** is available as a linear actuator, part no. 5A702. It is manufactured by Dayton Electric Manufacturing Company with offices in Viles, Ill.

Alternate Harness Assembly

FIGS. **16–17** show an alternate harness assembly. FIG. **16** shows a front view of a user donning the alternate harness assembly and FIG. **17** shows a rear view. The alternate harness assembly comprises first section **500**, second section **501** and third section **502**.

For first section **500**, contoured hard plastic back-piece **505** is sewn into lightweight vest **507**. Metal loops **509** are then threaded into back-piece **505**. Flexible metal cable **511** is then threaded through metal loops **509**. Lower vest buckles **513** and upper vest buckles **515** are then attached to the ends of metal cable **511**. For second section **501**, straps **517** are sewn onto stretch pants **519**. Lower pants buckles **521** are attached to straps **517** near the ankle end and upper pants buckles **523** are attached to straps **517** near the hip end. For third section **502**, shoe buckles **525** are attached to user's shoes **527**.

Utilizing the Alternate Harness Assembly

To utilize the alternate harness assembly with the present invention, the user first dons first section **500**, second section **501** and third section **502**. Then, he buckles upper pants buckles **523** to lower vest buckles **513**. Then, he buckles shoe buckles **525** to lower pants buckles **521**. Then, to attach himself to the overhead support system, the user buckles upper vest buckles **515** to support system buckles **529** of harness connect assembly **583**.

As the overhead support system pulls upward on the user, the lifting force is directed down through cable **511** and through straps **517**. A portion of the lifting force is then directed to thigh straps **518** and another portion of the lifting force is directed downward to shoes **527**.

A major advantage of this embodiment of the alternate harness assembly is that the user is able to easily disconnect second section **501** from first section **500** by releasing lower vest buckles **513** from upper pants buckles **523**. This is an extremely valuable asset to users when, for example, they need to use the bathroom. Another advantage of this harness is that the vast majority of lifting of the user occurs around the lower body. This stands in contrast to harness systems that lift primarily from the upper body. Cables **511** function to keep the user upright. Moreover, because they are directed along the user's back, they do not interfere with forward mobility, freedom of motion or movement in front of the user. Also, this harness system may easily be worn underneath ordinary clothes.

Modifications to the Alternate Harness Assembly

The alternate harness assembly was described as having first section **500**, second section **501** and third section **502**. However, it would be possible to modify this embodiment so as to combine second section **501** and third section **502**. In other words rather than buckling lower pants buckles **521** to shoe buckles **525**, an embodiment could be made so that pants **519** also include stocking feet. Straps **517** would then connect directly to the stocking feet, which preferably would be made out of a strong material such as nylon so that a portion of the user's weight could be supported. Or straps **517** could be omitted completely and upper pants buckles **523** would attach directly to pants **19**. In this embodiment, pants **19** would preferrably be made out of a strong material such as nylon.

Applications

The present invention is valuable for many purposes. These include support for people with physical handicaps or people recovering from injury, joint replacements or surgery or people with a wide variety of diseases or disabling conditions such as Parkinson's, strokes or heart conditions. The invention can also be used to support animals or for the movement of equipment or toxic chemicals and it can be applied to assembly line production or meat processing. The present invention can be used by persons with no control at all over their legs. In this case the person's entire weight can be supported by the invention and he could provide the needed horizontal force by pulling or pushing on furniture or a special railing. Or if necessary the horizontal force could be provided by a hospital or nursing home attendant. Persons skilled in the art will recognize many other specific applications.

Persons skilled in this art will recognize many other changes and modifications which can be made to the present invention without departing from its spirit. Therefore, the scope of the present invention is to be determined by the appended claims and their legal equivalents.

I claim:

1. An overhead support system comprising:

A) an array of spoked rimless wheels located over a space, wherein said spoked rimless wheels are rotatably fixed in place,

B) at least one overhead cart riding on said array of spoked rimless wheels,

C) a tension element for supporting a load from said cart, wherein the load can be moved horizontally in random directions in the space by applying a horizontal force to the load causing said cart to move over said array of spoked rimless wheels carrying the load in the horizontal direction with at least a plurality of said spoked rimless wheels rotating to permit said tension element to pass horizontally through said array of spoked rimless wheels.

2. An overhead support system as in claim **1**, wherein the load is a human being.

3. An overhead support system as in claim **2**, and further comprising a harness means.

4. An overhead support system as in claim **2**, and further comprising a harness assembly.

5. An overhead support system as in claim **4**, wherein said harness assembly comprises:

A) a first section connected to said tension element, and

B) a second section removably connected to said first section,

wherein said first section directs the tension force from said tension element around the human being to said second section, and wherein said second section supports the human being and absorbs the tension force.

6. An overhead support system as in claim **1**, further comprising a hoist assembly connected to said tension element.

7. An overhead support system as in claim **6**, further comprising a hand held remote, wherein said hoist assembly is controlled by said hand held remote.

8. An overhead support system as in claim **6**, wherein said hoist assembly is located above said array of spoked rimless wheels.

9. An overhead support system as in claim **6**, wherein said hoist assembly is located below said array of spoked rimless wheels.

10. An overhead support system as in claim **6**, wherein said hoist assembly comprises:

A) a take-up axis,

B) a drive motor to rotate said take-up axis, and

C) a rechargeable battery to power said drive motor.

11. An overhead support system as in claim **10**, wherein said hoist assembly is rigidly connected to said at least one overhead cart.

12. An overhead support system as in claim **1**, further comprising:

A) a lower lift platform support rod extending downward from said at least one overhead cart, and

B) a lower lift platform connected to said lower lift platform support rod,

C) a hoist assembly rigidly connected to said lower lift platform, wherein sail hoist assembly is connected to said tension element.

13. An overhead support system as in claim **1**, further comprising a plurality of spherical elements rollingly positioned between said riding surface and said overhead cart and attached to said cart or to said riding surface.

14. An overhead support system for assisting in the horizontal movement of a human being, defining a body weight, said system comprising:

A) a slot track rigidly fixed in place, wherein said slot track defines straight sections, curved sections and intersecting sections,

B) at least one flat-bottomed overhead cart riding on said slot track,

C) a tension element for supporting a human being from said cart,

D) a plurality of rolling elements rollingly positioned between said slot track and said flat-bottomed overhead cart and attached to said slot track, wherein said plurality of rolling elements comprises a plurality of casters connected to said slot track top along said curved sections and along said intersecting sections, and further comprising a plurality of rolling wheel assemblies connected to said slot track top along said straight sections,

E) a lower lift platform support rod extending downward from said flat-bottomed overhead cart,

F) a lower lift platform connected to said lower lift platform support rod, and

G) a motor driven hoist assembly rigidly connected to said lower lift platform, wherein said motor driven hoist assembly is connected to said tension element,

wherein the human being can be moved horizontally along said slot track by a horizontal force being applied to the human being, wherein support of the body weight of the human being is distributable between the human being's feet on the floor and said overhead support system.

15. A method for moving a human being horizontally through a space, comprising the steps of:

A) placing the human being, defining a body weight, in an overhead support system, said overhead support system comprising:

1) a slot track rigidly fixed in place, wherein said slot track defines straight sections, curved sections and intersecting sections,

2) at least one flat-bottomed overhead cart riding on said slot track,

3) a tension element for supporting a human being from said flat-bottomed overhead cart,

4) a plurality of rolling elements rollingly positioned between said slot track and said flat-bottomed overhead cart and attached to said slot track, wherein said plurality of rolling elements comprises a plurality of casters connected to said slot track top along said curved sections and along said intersecting sections, and further comprising a plurality of rolling wheel assemblies connected to said slot track top along said straight sections,

5) a lower lift platform support rod extending downward from said flat-bottomed overhead cart,

6) a lower lift platform connected to said lower lift platform support rod, and

7) a motor driven hoist assembly rigidly connected to said lower lift platform, wherein said motor driven hoist assembly is connected to said tension element, and

B) applying a horizontal force to the human being, wherein support of the body weight of the human being is distributable between the human being's feet on the floor and said overhead support system.

16. A method as in claim **15**, wherein said step of applying a horizontal force to the human being is accomplished by an assistant pushing the human being.

17. A method as in claim **15**, wherein said step of applying a horizontal force to the human being is accomplished by the human being walking.

18. An overhead support system as in claim **14**, further comprising a plurality of spherical elements rollingly positioned between said slot track and said overhead cart and attached to said cart or to said slot track surface.

19. A method as in claim **15** wherein said step of applying a horizontal force to the human being is accomplished by a combination of an assistant pushing the human being and the human being walking.

20. An overhead support system as in claim **14**, further comprising a hoist assembly connected to said tension element.

21. An overhead support system as in claim **20**, further comprising a hand held remote, wherein said hoist assembly is controlled by said hand held remote.

22. An overhead support system as in claim **20**, wherein said hoist assembly is located above said slot track.

23. An overhead support system as in claim **20**, wherein said hoist assembly is located below said slot track.

24. An overhead support system as in claim **20**, wherein said hoist assembly comprises:

A) a take-up axis,

B) a drive motor to rotate said take-up axis, and

C) a rechargeable battery to power said drive motor.

25. An overhead support system as in claim **24**, wherein said hoist assembly is rigidly connected to said at least one overhead cart.

26. An overhead support system as in claim **14**, wherein support of the weight of the human being is adjustably distributed between the floor and said overhead support system.

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